SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MAY, 1930.

GENERAL PHYSICS.

1696. Construction of Scales for Lever Balances. J. J. Wassiljew. *Zeits. f. Instrumentenk.* 49. *pp.* 557–566, *Nov.*, 1929.

The type of balance considered consists of a bell-crank lever with two unequal arms, one of which carries the unknown weight and the other a fixed weight; in a second type the two arms carry weights which it is desired to compare. In either case, a pointer attached to the lever moves over a scale, which may be direct-reading in weight (type 1) or in the weight-ratio (type 2). The theory is worked out in detail, both formulæ and graphical methods for scale-graduation being derived, with special reference to balances for textile laboratories. The paper concludes with a description of a dividing machine for such scales. L. V. C.

1697. Errors in Time Measurements and Proposed Improvement of Astronomical Clocks. M. Schuler. *Phys. Zeits.* 30. *pp.* 884–887, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The author discusses at length sources of error in the measurement of time, whether due to instrumental variations or to disturbances produced by the planetary system. He then critically examines the accuracy of the Shortt astronomical clocks at Greenwich with illustrative curves, and concludes with a description of a new pendulum clock which he has installed at the Göttingen Observatory. For technical details Abstract 433 (1930) should be consulted. H. H. Ho.

1698. New Electrical Equipment of Pendulums and Observational Instruments installed at Geneva Observatory. P. Rossier. *Arch. des Sciences*, 11. *pp.* 345–361, *Nov.–Dec.*, 1929.

New equipment for the measurement and signalling of time, installed at Geneva Observatory, is briefly described. J. S. G. T.

1699. Study of Elinvar Spring in the Galitzin Vertical Seismograph at Kew Observatory. F. J. Scrase. *Journ. Sci. Instruments*, 6. *pp.* 385–392, *Dec.*, 1929.

A serious defect of the Galitzin vertical seismograph is the drift of the pendulum which is caused by the effect of temperature changes on the elasticity coefficient of the steel spiral spring. In order to overcome this disadvantage an elinvar spring was recently fitted to the vertical seismograph at Kew Observatory. After loading the spring, the "creep" remained appreciable for several months. Moreover, the rate of "creep" was dependent on the temperature. After making due allowance for these effects it was found that the temperature coefficient of the elastic constant of the elinvar spring was about one-tenth of that of the steel spring.

AUTHOR.

1700. New Inertialess Chronograph. P. A. Cooper. *Phil. Mag.* 8. *pp.* 1100–1105, *Dec.*, 1929.

The use of a gas discharge lamp of the "Osglim" type for recording purposes is subject to the disadvantage of the uncertain delay which occurs between the instant at which the requisite voltage is applied to the lamp and that at which the discharge strikes; further, the lamp is not well adapted for photographic purposes. These difficulties have been overcome by using an argon-filled lamp with three iron electrodes, the two outer ones being kathodes, each of which could be made to glow independently of the other. To prevent any lag in the lighting up of the lamp use is made of a pilot-circuit having a resistance of about 50,000 ohms, which is sufficient to ionise the space between one of the kathodes and the central anode. This resistance is short-circuited when the event to be observed is about to be recorded on the lamp. Instead of using simple make-and-break contacts, each of the kathodes may be connected to the plates of a thermionic valve of low impedance. W. C. S. P.

1701. General Theory of Synchronisation. J. Haag. *Comptes Rendus*, 189. *pp.* 1244–1246, *Dec.* 30, 1929.

The theory of synchronisation of the oscillations of an oscillating system subjected to periodic escapement action is given. It is shown that the most general case of sustained action of the escapement can be reduced to a case of instantaneous action. The effects of amplitude, velocity and motion of the oscillator and external perturbations, *e.g.*, friction, are briefly discussed. J. S. G. T.

1702. New Extensometer. J. Zahradníček. *Phys. Zeits.* 30. *pp.* 925–927, *Dec.* 15, 1929.

An account of an apparatus for the determination of Young's Modulus of two steel wires, based on a method due to B. Macku. The two wires are stretched vertically between two cross rods. The motion of the lower rod on applying the load is magnified by having it in communication with a chamber filled with mercury. Use is made of a piston which compresses or relaxes a rubber membrane causing the mercury to rise or fall in a capillary tube attached to the chamber. This enables the extension to be magnified 100 to 200. The apparatus is calibrated by means of a micrometer gauge. W. C. S. P.

1703. Two Hot-Wire Viscometers. E. G. Richardson. *Journ. Sci. Instruments*, 6. *pp.* 337–343, *Nov.*, 1929.

Instruments based on the convective cooling of an electrically-heated wire, for giving the distribution of velocity across a liquid (*a*) flowing in a cylindrical tube, (*b*) flowing in the annular space between two concentric cylinders, one rotating and the other at rest, are described. As examples of their use, the velocity gradients in a number of liquids at various stages between stream-line and turbulent flow are shown, and compared with the forces producing the flow. The use of a hot-wire and a string galvanometer to detect unsteady flow is illustrated. AUTHOR.

1704. New Micro-Method for Measuring the Diffusion of Colourless Substances. R. Zuber. *Phys. Zeits.* 30. *pp.* 882–884, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The principle of the method now described in detail is based on the fact that increase of concentration by diffusion may be measured by change of refractive index, for which a suitable apparatus has been designed.

H. H. Ho.

1705. Capillarity. Evaporation in Capillaries. K. Schultze. *Kolloid Zeits.* 49. *pp.* 265–270, *Nov.*, 1929.

The evaporation of aqueous salt solutions in cylindrical and prismatic capillaries is influenced by many factors. The salt concentration is highest in the neighbourhood of crystals formed; the vapour tension of the solvent decreases as the concentration increases. Vapour saturation will not be attained at the open end of a capillary exposed to air currents, but the air will be saturated with moisture at the depth of a meniscus. When no salt is found in a dried capillary, the solution may have diffused away. Evaporation is favoured by higher temperature, by the formation of branch capillaries and in short lengths of curved capillaries, further by the formation of crystals which narrow the passages and enlarge the areas from which evaporation can take place. All the factors which promote the diffusion of the salt in the water cause deposition of salt in the interior of the capillary. Inhibition of this diffusion leads to migration of the salt to the outside. [See also Abstracts 2889 and 2890 (1929).] H. B.

1706. Preparation of Very Pure Mercury. H. v. Steinwehr and A. Schulze. *Zeits. f. Instrumentenk.* 49. *pp.* 566–567, *Nov.*, 1929.

Methods of purification employed at the Reichsanstalt are described. Mercury of commerce is freed from grease by benzene or alcohol, washed with dilute nitric acid, filtered through a porcelain filter and twice distilled under reduced pressure (common water-pump). The still is of a straightforward character and contains no taps; the receiver is attached by means of a ground joint. A fine stream of air from a capillary bubbles through the mercury during distillation. The mercury undergoes no change if stored in a sealed and evacuated glass vessel; it reacts with the glass, however, if air be present. Independent determinations of its electrical resistance agree to within a few parts in a million. L. V. C.

1707. Attraction Phenomena in Mercury in a High Vacuum. W. I. Romanoff. *Phys. Zeits.* 30. *pp.* 871–876, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

Works out mathematically a theory for the sticking of the mercury in the capillary of the McLeod's manometer, when the original pressure of the air is so low that no bubble is left at the top of the capillary. The attraction, when the quantity of gas involved is so small that the adsorbed portion is not sufficient to cover the surfaces of the mercury and of the glass with a monomolecular layer, is made up of that between the portions of the clean surfaces of glass and mercury which are in contact with one another, that between the portions of clean surface of glass or mercury which are in contact with the monomolecular layer covering the neighbouring mercury or glass, and that between the portions of the monomolecular surfaces covering mercury and glass which are in contact with one another. The resulting formula is compared with the experimental measurements, and general agreement is found. The initial volume of the gas and the diameter of the capillary tube are of importance only as far as they determine the thickness of the final gas layer. The observation of the attraction curves should make it possible to judge of the attraction constants for different substances. H. N. A.

1708. Experimental Study of the Energetics of Imbibition Phenomena. C. E. Guye and H. Saini. *Helv. Phys. Acta,* 2. 7. *pp.* 445–491, 1929. *In French.*

In the course of the imbibition of liquids by porous solids (*e.g.*, sap rising in trees) work is done against gravity and against viscous forces and some energy is directly converted into heat. The sum of these quantities is equal to the loss in surface energy of the solid on being wetted by the liquid (neglecting slight changes in kinetic energy during the process). A general theoretical discussion, making the assumption that imbibition is complete immediately behind the advancing head of liquid, leads to a power series connecting the distance travelled by the latter with the time; for horizontal imbibition the series reduces to a quadratic form. Experiments on the imbibition of blotting paper with water, petrol and oil of vaseline show that this general assumption is invalid at distances greater than 15–20 cm. The phenomena may still, however, be represented by a power series; in the case of petrol and water the first 12 cm. of vertical advance are represented (to 1 %) by a quadratic relation, the first 25 cm. by a cubic and the first 100 cm. by an equation of the fifth degree. In conformity with theory the rates of advance vertically and horizontally are identical for very short distances. The experiments show that the energy converted directly into heat is comparable with the quantities used in overcoming gravity and viscosity. Of the two latter, the expenditure on gravity (reversible) preponderates at great heights; that dissipated irreversibly in overcoming viscous forces preponderates for small heights of ascent. L. V. C.

1709. Viscosity of Vapours of Organic Compounds. Part I. T. Titani. *Chem. Soc. Japan, Bull.* 4. *pp.* 277–287, *Dec.,* 1929. *In English.*

The viscosities of seventeen organic compounds in the form of gases were determined. The apparatus was capable of being used with very small quantities of gas, and it was possible to carry out measurements at different temperatures with a single filling. The following compounds were used: ethane, propane, *n*-butane, isobutane, propylene, α-butylene, β-butylene, isoamylene, acetylene, allylene, trimethylene, methyl-ether, methyl-chloride, methyl bromide, and sulphur dioxide. The results of the determinations are to be published in Part II of the investigation. F. J. B.

1710. Viscosity Formula for Binary Mixtures. Part IV. T. Ishikawa. *Chem. Soc. Japan, Bull.* 4. *pp.* 288–297, *Dec.,* 1929. *In English.*

In two previous publications [see Abstracts 2055 and 3453 (1929)] the author developed formulæ for the viscosities of chemically indifferent binary mixtures. The present paper is the result of a further study of a field constant *k*, which is a measure of the molecular field of attraction, and is shown to be a characteristic property of each liquid. The association of the constituents of the binary mixtures was taken into account. The binary mixtures studied were: benzyl benzoate in benzene, and in toluene, guaiacol in benzene and in toluene, ethyl ether in ethyl alcohol, and in n-propyl alcohol, chlorbenzene in phenol and phenol in benzene. The data for these mixtures were taken from the literature and the formula led to satisfactory results. F. J. B.

1711. Spreading of Lubricants over Solid Surfaces. Molecular Influences. Effect of Photolysis. P. Woog. *Comptes Rendus*, 189. *pp.* 977–979, *Dec.* 2, 1929.

It has been found that, unlike the majority of organic acids which when added to a drop of oil on a solid surface check its spreading over the surface, acids which do not possess the properties of orientation and of resistance due to a polar or symmetrical constitution, such as monobasic acids originating from a cyclical nucleus, prevent the formation of a marginal barrier in oils to which they are added, and cause the oil to spread; examples are benzoic, phenylacetic, cinnamic, *o, m* and *p* toluic acids. Photolysis either by exposure of the oil to direct sunlight, or to light from a mercury arc in quartz, produces active bodies which are not capable of forming stable molecular marginal barriers, and so produce a spreading of the oils. H. N. A.

1712. Damping a Pendulum by Viscous Media. F. E. Hoare. *Phil. Mag.* 8. *pp.* 899–909, *Dec.*, 1929. *Supplement.*

A description of some experiments to develop an alternative method for the measurement of viscosity. The equation of motion of a pendulum consisting of a sphere attached to a fine wire and performing oscillations in a vertical plane, the sphere being immersed in a viscous medium, is discussed. The general arrangements for the experiments are given. As a result of the logarithmic decrement experiments it was found that the assumption of successive amplitudes being in geometrical progression and thus that the resistance experienced by the sphere is directly proportional to the velocity is unjustifiable. The author propounds a modified theory to account for the variation of the damping, and results are given for 2-in., 1¾-in. and 1½-in. spheres. T. C. H.

1713. Vortex Motion near Semicircular Boundaries and Infinite Straight Boundaries with Semicircular Projections. K. De. *Calcutta Math. Soc., Bull.* 21. *pp.* 197–202, *Sept.–Dec.*, 1929.

The method of conformal transformation is employed to deduce the paths of vortices within a semicircular boundary or an infinite straight boundary with semicircular projections. The plotting of the paths, in each case, is carried out solely by length measurements, without having recourse to trigonometrical or other calculations or constructions. J. S. G. T.

1714. Stability of a Kármán Vortex Street in a Channel of Finite Breadth. Part II. S. Tomotika. *Phys. Math. Soc. Japan, Proc.* 11. *pp.* 149–163, *Dec.*, 1929.

In continuation of previous work [see Abstract 3457 (1929)], the author discusses the stability of a vortex street in a channel of finite breadth, the complex velocity potential for the street being expressed in terms of doubly periodic functions. Two possible types of configuration of the vortices, symmetric and unsymmetric respectively, are derived, under the condition that the vortices must retain their positions on two straight lines parallel to the channel walls. A perfectly general type of possible small disturbance being applied to the system, it is shown that the vortex street of symmetric type is absolutely unstable. On the other hand, the symmetric type may have at least one, or at most two, essentially stable configurations, if the ratio of the breadth of the street to that of the channel lies between the values 5/16 and 3/8 approximately. J. S. G. T.

1715. Application of General Formulæ for Cauchy's Integral to a Problem of Hydrodynamics. N. Théodoresco. *Comptes Rendus*, 189. *pp*. 969–971, *Dec*. 2, 1929.

A memoir by Korn on the equilibrium of elastic plates (*Annales de l'École Normale*, 3. 25. p. 529, 1908) discusses the integration of the equations of stationary motion of a liquid under friction, and the present author now deals with the same problem by his method [see Abstract 877 (1930)] for the integration of equations in plane elasticity. H. H. Ho.

1716. Existence of Two Systems of Turbulence Behind Immersed Solids. J. Courrégelongue. *Comptes Rendus*, 189. *pp*. 972–974, *Dec*. 2, 1929.

The two turbulence systems which are now established as existing in the wake of an immersed solid, are also found to coexist constantly between certain limits of the Reynolds' number. The two cases are discussed between these limits when: (1) the solids have different diameters, the stream velocity being constant, and (2) the same obstacle is immersed in streams of different velocities. H. H. Ho.

1717. Formula for Calculating the Resistance of a Solid in a Perfectly Incompressible Fluid. J. Pérès. *Comptes Rendus*, 189. *pp*. 1246–1248, *Dec*. 30, 1929.

A formula, analogous to that derived by Synge, for the force experienced by a fixed cylinder immersed in a perfectly incompressible fluid subjected to periodic motion, is developed, without the postulation of the existence of a velocity potential. J. S. G. T.

1718. Analogy between Electrical and Aerodynamic Fields. C. Ferrari. *Accad. Sci. Torino, Atti*, 64. 9*a*–10*a*. *pp*. 190–196, 1928–1929.

The author explains how the analogy between electrostatic and aerodynamic fields permits of obtaining in an experimental way the configuration of the aerodynamic field around a body of any form whatever. J. J. S.

1719. Rate of Molecular Collisions in Liquid Systems. M. Jowett. *Phil. Mag*. 8. *pp*. 1059–1072, *Dec*., 1929.

The calculation of the rate of collision in liquids by applying to liquids the kinetic theory of diffusion was attempted. The concept of persistence of velocity was used in the calculations. The method gave higher values for the collision rates than were calculated by gas formulæ. The values obtained were higher by a multiple which was probably constant for each liquid medium at any one temperature, and the approximate formulæ developed for calculating this multiple gave a value of the order of 10. The temperature coefficient of collision rates was shown to be negative, and approximately equal to that of viscosity. F. J. B.

1720. Problems in Elasticity. G. Supino. *Accad. Lincei, Atti*, 10. *pp*. 502–508, *Nov*. 17, 1929.

Solutions of the following problem are considered: being given an elastic solid limited by the surface σ, if it is divided into two zones σ_1 and σ_2, and on one of these the distribution of the forces is given, on the other the resultant and the resultant moment of the forces, then the elastic tendency is not unequivocally determined. The preferable solution to be chosen amongst the infinite number of solutions which satisfy the conditions laid down is discussed mathematically, the fundamental solution being taken as that which, while satisfying the assigned conditions, renders the work of deformation a minimum. Some practical examples of solutions are given, such as the flexion in an arch of circular axis with section normal to the axis constant. J. J. S.

1721. Elastic Moduli of Alkali Halides. P. W. Bridgman. *Am. Acad., Proc.* 64. *pp.* 19–38, *Dec.,* 1929.

The methods used to grow rods of metals in the form of single crystals were not directly applicable to the preparation of similar rods of salts, and the necessary modifications are described in detail. Moulds of thin platinum foil had to be used. It was not possible to control the orientation of the crystal axes relative to the axis of the rod. Rod dimensions were of the order 5 cm. long and 0·28 cm. diameter turned in a jeweller's lathe to be true to 0·0002 cm. The uniformity of the crystals was tested by etching, and the orientation of the crystal axes was determined by the direction of the principal cleavage planes. Slight and obscure impurities were found to be of the greatest importance in growing crystals, and success was obtained only with KI, KBr, KCl, NaBr and NaCl samples of the highest obtainable purity. The elastic measurements were made by bending and twisting rods of various orientations. Slater's values for compressibilities were used in the calculations which showed that the Cauchy relation is satisfied, thus checking the expectation from Born's theory of the crystal lattice and, incidentally, its relation with the new wave mechanics. W. H. Ge.

1722. Theory of Imperfectly Elastic Bodies. H. Schlechtweg. *Ann. d. Physik,* 3. 7. *pp.* 997–1016, *Dec.* 18, 1929.

In this entirely mathematical paper an equation of motion is derived in imperfectly elastic media for sufficiently slow velocities, and its connection established with the equation of motion in an ideally elastic body, on the one hand, and the fundamental equation of hydrodynamics on the other. A special case of displacement led to a comparison with Wiechert's theory, which is now opined to be irrational. Considerations of energy-density have enabled a connection with the energy-density in ideally elastic and in liquid medium to be derived. Finally, a representation of displacement has been given for the special case of a very long infinitesimal extended cylinder. H. H. Ho.

1723. Effect of Pressure on Rigidity of Metals. P. W. Bridgman. *Am. Acad., Proc.* 64. *pp.* 39–49, *Dec.,* 1929.

The method used in this investigation has previously been used for similar measurements on glass. It is a differential method in which two helical springs are stretched against one another, one of the metal under examination and the other of a standard metal (steel) on which the effect has been determined by some absolute method. The following results are reported as percentage changes of rigidity under a pressure of 10,000 kg./cm.^{2}: W, − 0·3; Ta, + 0·3 to + 1·5; Mo, + 0·15; Zr, − 0·17; Pt, + 2·4; Th, + 5·7; Pd, + 1·1; Ni, + 1·8; steel, previous result + 2·2. The increase of rigidity under pressure is notably less than the increase of incompressibility, figures for which are given from previous work. C. O. B.

1724. Compressibility and Pressure Coefficient of Resistance of Several Elements and Single Crystals. P. W. Bridgman. *Am. Acad., Proc.,* 64. *pp.* 51–73, *Dec.,* 1929.

The effect of pressure on the electrical resistance of four metallic elements, and the compressibility of four elements, seven inorganic single crystals, four organic crystals and bakelite are measured. A new form of piezometer has been developed for those substances which dissolve in kerosene. The electrical resistance always decreases with rising pressure, except initially for arsenic, in which, at low pressures, the opposite is the case. Arsenic also shows a new polymorphic form at high pressures, the transition pressure being about 5500 kg./cm.^{2} at 30° C. The compressibility in crystals differs with different directions: this difference is very large for arsenic, and is generally larger for inorganic than for organic crystals.
G. C. McV.

1725. Thermodynamic Determination of the Compressibility of Water. W. Jazyna (Jacyno). *Zeits. f. Physik,* 58. 11–12. *pp.* 858–860, 1929.

By considering a thermodynamic cycle carried out in the neighbourhood of the freezing point (273° Abs.) and using Thomson's data on the lowering of the melting point of ice by pressure, a value for the mean compressibility (in the interval 1 to 129 atmospheres, 272° to 273° Abs.) is derived which is in complete agreement with the experimental value found by Bridgman, Richards, Stull and others. W. S. S.

1726. Possible Additive Character of Energy. T. Takeuchi. *Tohoku Math. J.* 32. *pp.* 50–51, *Dec.,* 1929. *In German.*

Frequencies in de Broglie's wave-theory are shown to be additive in character, so that the characteristic frequency of a system of masses is derived by summing the frequencies of the component masses. J. S. G. T.

1727. Impact of Spheres of Soft Metals. J. P. Andrews. *Phil. Mag.* 8. *pp.* 781–800, *Dec.,* 1929. *Supplement.*

In the first part of this paper the duration of contact during collision of two equal spheres of the same material is investigated with a ballistic pendulum, employing the partial discharge of a condenser to measure the duration. For aluminium, tin, brass, babbitt and a lead-tin alloy, a law of the form $t = t_0 + a/v^n$ is obtained, where v is the relative velocity at the moment of impact t_0, a and n being constants. Zinc follows a similar law, but the constants cannot be accurately determined. In the second part a description of the flattened areas remaining on the spheres after collision is given, and an explanation of the rim which surrounds them is offered. If d is the diameter of these rims, $d = b(v - v_0)^m$, where b, v_0 and m are constants different for different spheres. From v_0 and the elastic moduli of the materials the least pressure required to start flow is calculated in the various cases and is found to be of the order 10^9 dynes/cm. AUTHOR.

1728. Effect of Axial Restraint on the Stress in a Rotating Disc. W. G. Green. *Phil. Mag.* 8. *pp.* 993–1018, *Dec.,* 1929.

The stresses due to restraint have been taken as the system produced on the disc by symmetrical distributions of surface traction, acting on the outside faces of the complete disc at rest. The surface displacements arising from these distributions are assumed to neutralise those occurring in a disc rotating under no superficial tractions, *i.e.,* by a second stress system. The total stress-components when rotating under restraint are obtained by combining these two systems. H. H. Ho.

1729. Thermal and X-Ray Analysis of Anhydrous Calcium Chloride Mixed Crystal Systems. A. Ferrari and A. Inganni. *Accad. Lincei, Atti*, 10. *pp.* 253–258, *Sept.*, 1929.

With calcium chloride, cobaltous and ferrous chlorides from eutectics at 614° C. and 592° C. containing 54·3 and 44·5 % (mol.) of calcium chloride respectively. Manganese and cadmium chlorides give with all proportions of calcium chloride mixed crystals which decompose into their components at about 475° C. and 414° C. The behaviour of these systems indicates that the structure of calcium chloride differs from that of the rhombohedric chlorides of cobalt, iron, magnesium, manganese and cadmium, since none of such systems exhibit the complete miscibility devoid of maximum or minimum solidification temperatures regarded as characteristic of isomorphous mixtures. The diameters of the metal ions explain clearly the behaviour of the systems, the radii of the ions being Co 0·82, Mg 0·78, Fe 0·83, Mn 0·91, Cd 1·03 and Ca 1·06 Å. T. H. P.

1730. Crystal Structure of Cobalt, Ferrous and Manganese Iodides. A. Ferrari and F. Giorgi. *Accad. Lincei, Atti*, 10. *pp.* 522–527, *Nov.* 17, 1929.

The structure of these iodides is of the cadmium iodide type, the dimensions of the elementary cells being: cobalt iodide, $a = 3 \cdot 96$ Å., $c = 6 \cdot 65$ Å., $c : a = 1 \cdot 68$, density 5·75; ferrous iodide, $a = 4 \cdot 04$ Å., $c = 6 \cdot 75$ Å., $c : a = 1 \cdot 67$, density 5·39; manganese iodide, $a = 4 \cdot 16$ Å., $c = 6 \cdot 82$ Å., $c : a = 1 \cdot 64$, density 5·01. The dimensions of the unit cell of lead iodide, for which discordant values have been recorded, are: $a = 4 \cdot 53$ Å., $c = 6 \cdot 92$ Å; $c : a = 1 \cdot 53$. T. H. P.

1731. Mechanism of Space-Lattice Change in Different Crystal Modifications. H. Shôji. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 447–449, *Dec.*, 1929. *In English.*

It is assumed: (i) When a space-lattice of one modification of a substance is freely and continuously changed into that of another, the atoms or molecules which are most firmly bound together in the lattice have the greatest tendency to move always in groups during the change. For example, the Fe change can occur through the slip- or shear-like deformation along the octahedral planes of the face-centred cubic lattice or along the rhombic dodecahedral planes of the body-centred cubic lattice. Cf. also Co, NH_4Cl, NH_4Br, NH_4I and AgI. (ii) Change of lattice comes from change in the atoms or molecules themselves. (iii) The lattice of an optically active substance containing a spiral arrangement of atoms tends to be deformed like a spring—that is, with much greater changes of length in one direction than in perpendicular directions, *e.g.*, β-quartz and β-cristobalite or cinnabar and metacinnabar. (iv) Amorphous modifications occur when the velocity of transformation is small.

W. H. Ge.

1732. Allotropic Modifications of Sulphur. C. R. Platzmann. *Chem. Soc. Japan, Bull.* 4. *pp.* 235–243, *Nov.*, 1929. *In German.*

The cryoscopic constants for sulphur at its natural melting point 114·5° C. in a series of organic substances gave an average value of K = 213, corresponding to a latent heat of fusion of 14·1 cal. As a result of possessing only a small dielectric constant sulphur has only a small dissociating power, and it can be shown that acids form double molecules when dissolved therein. Arsenic trisulphide shows in dilute solution molecules of As_2S_3, while in concentrated solutions polymerisation occurs. Selenium tetrachloride shows only half the normal molecular weight as a result of forming selenium chloride and sulphur chloride. J. K.

1733. Tetrahedral Theory of the Carbon Atom. R. Hönig. *Zeits. f. Elektrochem.* 35. *pp.* 847–851, *Nov.*, 1929.

The space formulæ for a number of cyclic organic compounds are considered in relation to the views advanced by Loewen and by Bergmann and Mark. For graphite the crystal model developed differs from that indicated by Debye and Scherrer's X-ray method. T. H. P.

1734. Distribution of Charge in the Carbon Atom. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 2. *pp.* 10–11, *Dec.*, 1929.

Results recently obtained for the intensity of reflection of X-rays from diamond by Miss A. H. Armstrong give values for the F curve quite different from those of Ponte, but in fairly close agreement with the calculated curve. More accurate estimates are to be made of Z′ for the K electrons where previously a value equal to 6·0 was assumed. (See Abstract 3481 (1929).] R. S. R.

1735. Isotope of Oxygen of Mass 17. W. F. Giauque and H. L. Johnston. *Am. Chem. Soc., J.* 51. *pp.* 3528–3534, *Dec.*, 1929.

A new weak band recently discovered in the atmospheric absorption of oxygen by H. D. Babcock [see Abstract 58 (1930)] has been explained, and shows that an isotope of oxygen of mass 17, as well as the previously discovered Oxygen 18 [see Abstract 3478 (1929)], is present in the earth's atmosphere. On the basis of accurate intensity measurements by Babcock, 18–16 molecules are present to the extent of one part in 625 and 17–16 molecules to the extent of about one part in 5000. Thus Oxygen 18 has an abundance of one part in 1250 and Oxygen 17 about one part in 10,000. All of the above figures are maximum estimates. AUTHORS.

1736. Packing Effect in Atomic Nuclei. H. Wolff. *Phys. Zeits.* 30. *pp.* 812–815, *Nov.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

Using Aston's accurate determinations of atomic weights the contributions of the protons and the electrons to the packing defect are calculated separately. The mean value for the electrons is negative, and amounts to − 0·0031 per electron, taking the mass of a hydrogen atom as unit; possible reasons for this result are suggested. The contribution of a proton to the mass defect is of the order + 0·010 unit, and appears to diminish somewhat with increase of atomic weight. H. N. A.

1737. Determination of the Course of the Levels in the Periodic System from the Values for Group Eight. V. Dolejšek and K. Pestrecov. *Phys. Zeits.* 30. *pp.* 898–899, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The author's equation of the fourth degree for ν/R holds accurately for all six rare gases which have their places at the ends of the periods of the periodic table, and also for the elements which halve the first and second twofold periods. Still another element of the long period satisfies the equation, which apparently, like the others, has eight electrons in its external layer. Considers the result in connection with Sommerfeld's

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formula for the relativity levels, which represents Moseley's second-degree equation corrected by means of the relativity term. Arrives thus at the values of the quantum numbers n, k and δ, and the screening number γ. Uses the results obtained in applying the equation to the other elements by suitably varying the value of γ for them. H. N. A.

1738. Bohr's Theory of the Hydrogen Series. J. Zahradníček. *Zeits. f. Physik*, 59. 9–10. *pp.* 723–724, 1930.

From the classical condition $Ee/r^2 = mv^2/r$ and the following revised form of the quantum theoretical condition for the impulse moment: "the alteration of the potential energy of the electron between the orbits $r = \infty$, $v = 0$ and $r = r_n$, $v = v_n$ is $\Delta E_{pot} = mv_n^2 = nh\nu_n$", it is possible to deduce that $r_n = h^2n^2/4\pi^2 mEe$, $v_n = 2\pi Ee/hn$ and $\nu_n = 1/T_n = 4\pi^2 mE^2e^2/h^3n^3$. It is here assumed that the spectral emission is expressed by the equation $W_k - W_n = h\nu$. H. N. A.

1739. Atomic Weight of Chlorine. Ratio NOCl : Ag. A. F Scott and C. R. Johnson. *J. Phys. Chem.* 33. *pp.* 1975–1986, *Dec.*, 1929.

Nitrosyl chloride is prepared by one method by passing pure dry nitric oxide and chlorine cooled to about − 18° C. in an ice-salt mixture, and according to the second method treating sulphur dioxide with fuming nitric acid, and thereafter treating the addition compound so formed with hydrogen chloride. The products so formed are purified by fractional distillation in a vacuum. The ratio NOCl: Ag is determined nephelometrically and used to calculate the atomic weight of chlorine. It is confirmed that nitrosyl chloride decomposes photochemically, and this is a distinct disadvantage in the use of this compound in atomic weight work. The ratio obtained is $0{\cdot}606827 \pm 0{\cdot}0000017$, from which the atomic weight of chlorine is calculated to be 35·4565 (N = 14·008 and Ag = 107·880). J. K.

1740. Benzene Ring Problem. R. Reinicke. *Zeits. f. Elektrochem.* 35. *pp.* 877–880, *Dec.*, 1929.

The benzene model previously described [see Abstract 920 (1930)] and made up of equal cubes shows, in agreement with Mark's X-ray results (*Deut. chem. Gesell.*, *Ber.* 57. p. 1820, 1924), two or three different types of atomic linking. This is, however, not in accord with the generally accepted law of benzene substitution, which regards the six hydrogen atoms as equivalent. By a simple modification of the model not only is this requirement satisfied, but differences between the two rings of the naphthalene molecule are indicated. T. H. P.

1741. Atomic Forms Derived from Space Lattice Representations as Cause of the Spacial Aggregation in Molecules and Crystals. Part II. Oxygen and Doubly-Linked Carbon. Part III. Nitrogen. R. Reinicke. *Zeits. f. Elektrochem.* 35. *pp.* 880–909, *Dec.*, 1929.

The considerations already developed in relation to the structure of the benzene molecule [see Abstract 920 (1930)] are applied to the investigation of the space formulæ of numerous inorganic and organic compounds. T. H. P.

1742. General Theorem on Brownian Motion. B. Hostinský. *Phys. Zeits.* 30. *pp.* 894–895, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.,* 1929.

The general theorem derived states that in an enclosure at the walls of which any prescribed physical boundary conditions obtain, the concentration of particles at any point inside becomes after a sufficiently long time a function solely of the position of this point, and is independent of the initial density distribution of the particles. W. S. S.

1743. Lantern Slide Model of the Wave Electron. S. R. Milner. *Nature,* 124. *p.* 876, *Dec.* 7, 1929.

The model is based directly on the explanation of the wave-electron given by de Broglie. The model consists of a diagram of lines on a lantern slide which is moved across a fixed vertical slit in the lantern. The movement of the diagram of points seen on the screen corresponds to a moving electron with its attendant phases wave. W. S. S.

1744. Fundamental Remarks on Wave Mechanics. A. Sommerfeld. *Phys. Zeits.* 30. *pp.* 866–871, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.,* 1929.

Recognises the advantages that have been gained by Heisenberg's use of the matrix calculus, avoiding the use of models; but considers that on the whole the influence of the Machs positivism, which mistrusts even the atomic theory, has been hurtful. The error of the original quantum theory was not the introduction of unobservable magnitudes, but its too strong confidence in classical mechanics. Considers the role of the model of the atom in wave mechanics, and the corpuscular electron; both are still necessary, only the mathematical method of treating them is changed. The special axiom with regard to whole number quantum rules has become unnecessary, this implies a unification and simplification of the theory even if the mathematical apparatus necessary has been made somewhat more difficult. The new theory implies the existence of quanta, though the name may be avoided. The widened " causality " of quantum physics may be said to deal with the linking up of the initial and final states in natural occurrences, since it is a question of the probability of passage from a certain initial state to one of several possible final states. In connection with the nature of the electron considers the necessity of a dualism in the theory, since in connection with the diffraction of the electron it is necessary to treat it as a wave, while in other cases it acts like a corpuscle. The same is true of the quantum of light. Recalls the monads of Leibniz, which were part spirit and part material. Happily, physics has enough to do in this generation without troubling much about problems of this nature. H. N. A.

1745. Wave Mechanics and Universal Vibrations. A. Korn. *Phys. Zeits.* 30. *pp.* 887–889, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.,* 1929.

The classical Hamilton-Jacobi partial differential equation representing the motion of a particle in a force field is modified by allowing the particle to be weakly compressible and to possess a certain equation of state. This gives certain small motions superimposed on the classical motion, which are analogous to the wave vibrations of Schrödinger's wave mechanics. W. S. S.

1746. Possibilities of Development in Continuity Theory. E. Lohr. *Phys. Zeits.* 30. *pp.* 889–893, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.,* 1929.

The author discusses the possibility of developing the " continuity theory " (representation of all chemical and physical phenomena by near

action and differential laws without any hypothesis as to the corpuscular structure of matter or any electron hypothesis) due to Jaumann and Machs, so as to embrace so-called corpuscular and quantum effects. The relation of such a development to the Schrödinger wave theory is indicated.
W. S. S.

1747. Wave Particles. L. Flamm. *Phys. Zeits.* 30. *pp.* 893–894, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

Commenting on the failure to obtain satisfactory wave packets composed of the material waves satisfying Schrödinger's equation, it is suggested that a more fundamental wave equation may be found representing the action of wave on wave and not embodying the action of the field on the complete particle as is the case in Schrödinger's and in Dirac's wave equations. By allowing a dependence of wave velocity on the magnitude of the wave function, it must be possible to obtain wave particles which retain their individuality, and possess a sharp frequency. W. S. S.

1748. Quantised Rotation of the Thallium Atom. R. G. Loyarte. *Phys. Zeits.* 30. *pp.* 923–925, *Dec.* 15, 1929. *Univ. Nac. la Plata, Estudio Ciencias, No.* 89. *pp.* 33–38, *Dec.*, 1929.

Spectroscopic evidence is submitted to show that certain unclassified emission lines of thallium which appear in the absorption spectrum belong to a line system which is displaced from the series lines by an amount equal to 7571·8 in wave number units. Analogously to the case of the mercury atom, this is attributed to a quantised rotation of the thallium atom. Assuming that this corresponds to the discrete energy value of a free axis rotator, as given by wave mechanics, the moment of inertia of the thallium atom about an axis through the centre of gravity is derived. This agrees in order of magnitude with the moment of inertia of the electrons about an axis through the nucleus, as deduced from the electron theory of magnetism, using for the atomic susceptibility that found experimentally for solid thallium. W. S. S.

1749. Wave Mechanics and the Dual Aspect of Matter and Radiation. A. M. Mosharrafa. *Roy. Soc., Proc.* 126. *pp.* 35–40, *Dec.* 2, 1929.

The uniform motion of a Lorentz electron is represented by an equation $\phi(x, y, z, t) = \text{const.}$, which for any value of t defines the surface of the electron. It appears that

$$\phi(x, y, z, t) \equiv x^2 + y^2 + z^2 - c^2t^2 + \frac{1}{m_0^2c^2}\{W(x, y, z, t)\}^2,$$

where W is the action function and the Schrödinger wave surfaces are given by W = const. Thus, the electron surface always passes through the curves of intersection of a Maxwellian wave-front and two Schrödinger wave surfaces, and the particle aspect of the electron is associated with the interference of these two waves. In general, for a given value of t however, the intersections in question are imaginary curves in Galilean space. For an observer moving with the velocity of light the Schrödinger wave-fronts and the electron surface coalesce, and the electron appears as a radiation phenomenon. It is suggested that to such an observer our radiational phenomena will be interpreted as material effects. W. S. S.

1750. Determination of the Range of Frequencies within the Group of Mechanical Waves of an Electron. H. T. Flint. *Roy. Soc., Proc.* 126. *pp.* 40–43, *Dec.* 2, 1929.

Representing an electron by a group of material waves in a narrow frequency wave $\Delta\nu$, the resultant displacement corresponds to a wave with varying amplitude, and it is shown that the distance between successive maxima l is given by $\Delta\nu \, . \, l = av$, where v is the velocity of the electron, and a lies between 1·43 and 1·0, depending on the distance from the central maximum. If, as suggested elsewhere [see Abstract 1184 (1928)], the smallest observable length associated with the moving electron equals $\frac{h}{m_0c} \, . \, \beta \, . \, (1 - \beta^2)^{-\frac{1}{2}}$, then l must be greater than this or $\Delta\nu < m_0c^2(1 - \beta^2)/h$, or $\frac{\Delta\nu}{\nu} < (1 - \beta^2)^{\frac{1}{2}}$. Thus, for high velocities the electron behaves more and more like a monochromatic set of waves as v approaches c, and actually becomes monochromatic at $v = c$. The extent of the range of material waves, $\Delta\nu$, is expected to be of importance in scattering phenomena. W. S. S.

1751. Probability Current in Dirac's Extension of Wave Mechanics. W. Alexandrow. *Zeits. f. Physik*, 56. 11–12. *pp.* 818–829, 1929.

Dirac's theory gives a probability density l_0 and a probability current vector (l_x, l_y, l_z). It is shown that for plane " matter waves " (homogeneous corpuscular radiation), the quantity $v = \frac{(l_x^2 + l_y^2 + l_z^2)^{\frac{1}{2}}}{l_0}$ satisfies the equation $\lambda = \frac{h}{mv}\left(1 - \frac{v^2}{c^2}\right)^{-\frac{1}{2}}$, where λ is the wave-length of the material waves. This is precisely the de Broglie formula for λ if v is interpreted as the particle velocity. The notions of particle velocity and particle orbit are thus reintroduced into the theory by means of the probability current vector and the probability density. By allowing the velocity of light to tend to infinity the non-relativistic form of the Dirac theory is arrived at. This involves only two wave functions, but the probability density and probability current notions are conserved. Using this simpler form, the field lines of the probability current are derived for the cases (*a*) magnetic deflection of kathode rays, (*b*) electron in the ground orbit of hydrogen, (*c*) two-dimensional harmonic oscillator. In each case the orbit and particle velocity as given by classical theory are reproduced.

W. S. S.

1752. Energy Interchanges between Atomic Systems in Quantum Mechanics. J. Frenkel. *Zeits. f. Physik*, 58. 11–12. *pp.* 794–804, 1929.

A mathematical paper giving a criticism of the Kallmann–London theory of collision states [see Abstract 2361 (1929)]. For this theory a more accurate one is substituted, based on the Born–Dirac treatment of collision problems. The quantum form of the Lorentz collision-damping theory is developed, and results in a more accurate theory than that of Kallmann and London. G. C. McV.

1753. Distant Parallelism and Wave Mechanics. R. Zaycoff. *Zeits. f. Physik*, 58. 11–12. *pp.* 833–840, *and* 59. 1–2. *pp.* 110–113, 1929.

A five-dimensional cylindrical geometry based on the axiom of distant parallelism, as a basis of a unified field theory, is discussed. The twenty-eight field equations are derived, and the characteristics of the matrices employed in the analysis are explained. [See also Abstracts 521 and 528 (1930).] J. S. G. T.

1754. Relativistic Treatment of the Problem of Several Bodies. L. Goldstein. *Comptes Rendus*, 189. *pp.* 984–986, *Dec.* 2, 1929.

Dirac's relativistic theory of the electron meets fundamental difficulties when dealing with atoms with several electrons. The Minkowski universe, or one with four dimensions, does not make it possible to deal with the problem, and Schrödinger's prerelativistic theory shows that the total amplitude Ψ of the problem can only exist in a configuration space. The propositions of Eddington and of Gaunt for generalising Dirac's formula to include the problem of two or n electrons hardly seem to be satisfactory. Breit has given an equation for the helium problem, using Darwin's relativistic solution of the two-body problem; his equation includes the retarded potentials which are neglected by Eddington and Gaunt. The equation of propagation can only be written in a different multiplicity of the Minkowski universe, that is, in an abstract multiplicity. The author gives this equation, and explains the symbols employed. This is contained implicitly in Breit's work, but it seemed worth while to define it. It is necessary in treating the problem to add to the 4-dimensional universe a configuration universe, just as in the non-relativistic treatment of the same problem a configuration space has to be added to ordinary space. A configuration time is also required. Some details are given of the results obtained. H. N. A.

1755. Melde's Experiment and Sommerfeld's Conditions. L. Décombe. *Comptes Rendus*, 189. *pp.* 1251–1253, *Dec.* 30, 1929.

The result obtained in the author's recent paper on the emission of light holds when the velocity of the electron in its orbit is so small that $\sqrt{1 - v^2/c^2}$ can be taken as equal to unity, so that there can be a closed orbit. Deals now with the case of large v, when it is necessary to consider two different frequencies, one radial and the other azimuthal; and uses the analogy of the Melde experiment with two tuning forks of different frequencies. Obtains results which agree with Sommerfeld's conditions of quantification. H. N. A.

1756. Levi-Civita's Modification of Einstein's Unified Field Theory. G. C. McVittie. *Phil. Mag.* 8. *pp.* 1033–1040, *Dec.*, 1929.

Levi-Civita's theory is applied to the particular case of the gravitational field of an electrostatic field of uniform direction, and the results obtained are compared with those derived in a previous paper [see Abstract 3271 (1929)] by the application of Einstein's theory. The congruences of Levi-Civita's theory establish at each point the same four orthogonal unit vectors used by Einstein to define distant-parallelism in the field. The lattice-tensor or invariant corresponding to the electromagnetic potential tensor is shown to be proportional to the average curvature of the congruences. J. S. G. T.

1757. Terrestrial Gravitational Field. U. Crudeli. *N. Cimento*, 6. *pp.* 371–377, *Nov.*, 1929.

The author discusses his views and considerations which tend to support in a general way the Miller effect without having recourse to deviations from the Einsteinian bases of the gravitational fields. J. J. S.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

1758. Atmospheric Ozone. G. M. B. Dobson. *Gerlands Beitr. z. Geophys.* 24. 1. *pp.* 8–17, 1929. *In English.*

The author summarises existing knowledge relating to the methods of measurement of the thickness and height of the ozone layer. The amount of ozone is found by Duckert closely associated with the air density at and above 15 km. and by the author with pressure at 9–16 km., while for air temperature there is a close connection for the upper troposphere, but small for the lower troposphere. With varying latitudes the amount is least near the equator and greater towards the poles, while the seasonal variation increases considerably towards the poles. Solar radiation is not responsible for ozone formation, since the amount at the poles is greatest at the end of the long dark winter. It is possibly due to auroral action at a level below the visible aurora as shown by its greater amount on magnetically disturbed days. Further observations are required to show its effect on weather at the earth's surface. **O. Hoelper** refers to the effect of dust and other particles in the atmosphere causing scattering, and a decreased intensity of the ultra-violet radiation depending upon the actual wave-length. **F. Linke** suggests that differences in the turbidity and therefore transparency of the air may account for some of the differences found for the ozone content. He suggests comparable observations from spectrographs, one at the foot and the other at the top of a mountain to test this. R. S. R.

1759. Amounts of Ozone in the Upper Atmosphere during the Day and Night. D. Chalonge and F. W. P. Götz. *Gerlands Beitr. z. Geophys.* 24. 1. *pp.* 20–25, 1929.

Measurements were made first in Paris and later at Arosa of the thickness of the ozone layer during the day and night. A quartz spectrograph was used and excellent spectra down to 3050 Å. were obtained in 15 sec., while with an elevation of 10° above the horizon ten minutes was required. Nine wave-lengths between 3115 and 3158 Å. were used, and on account of doubts regarding the absorption coefficients the results for the thickness of the ozone layer differ among themselves, while the mean differs from the value obtained by Dobson's spectrograph. It is concluded that if variations occur in the thickness of the ozone layer, they are small in our latitudes, but large changes occur in polar latitudes during the long nights. R. S. R.

1760. Spectral Transparency of the Atmosphere. O. Hoelper. *Gerlands Beitr. z. Geophys.* 24. 1. *pp.* 26–29, 1929.

The effect of the origin and composition of the atmosphere on its transparency for solar radiation was shown by a comparison of observations made at Norderney on (1) Sept. 1, 1928, in an air mass of maritime polar origin, and (2) Sept. 5, 1928, when this was replaced by subtropical air flowing round an anticyclone. The effect of molecular scattering increases much more rapidly than that of absorption, as the water-vapour content increases, and the limiting wave-lengths transmitted will also alter. Thin air layers will weaken the long-wave more than the short-wave ultra-violet radiation, but for thicker layers the shorter waves are absorbed, and relatively more long-wave radiation is transmitted.

R. S. R.

1761. Abnormal Atmospheric Extinction. F. Becker and N. Tapia. *Zeits. f. Physik*, 58. 11–12. *pp.* 742–748, 1929.

The authors have studied the records of photometrical measurements of the solar spectrum made at the observatory of La Paz in Bolivia; the daily curve for extinction was found to be asymmetrical in relation to the meridian, the maximum intensity being observed at about 3 p.m.; this appears to be due to the situation of the observatory with regard to the city. It is pointed out how important such anomalies may become in connection with observations on variable stars. H. N. A.

1762. Vertical Air Currents as Measured by Pilot Balloons. A. J. Bamford. *Roy. Meteorolog. Soc., J.* 55. *pp.* 363–381; *Disc.*, 381–384, *Oct.*, 1929.

An account of the work done at Colombo on the vertical velocities of pilot balloons. The method adopted was to take the theoretical rate of rise of the balloon as derived from its free lift and weight, by using the Dines formula, and to express the actual vertical velocity, derived from the tail method, as an offset from this quantity in m. per min. The curve of average offsets of vertical velocity against height up to 11 km. correspond to a faster rate of rise than given by the Dines formula, but there is a drop on the curve between ½ and 1 km. indicating that the velocity during the second half km. must be less than the theoretical value. The author suggests that these results may be explained by local convection currents set up near the surface of the earth, in the form of rolling whirls of several hundred metres radius. He considers the probable effect of such a whirl on the motion of a number of balloons, and shows that their resultant motion on an average would agree with the average of the observations. In the *Discussion*, the tail method of observation is criticised; and it is suggested that the apparent upward velocity of the air above 5 km. may be ascribed to an error in the pilot-balloon formula as the balloon expands.

W. C. S. P.

1763. Numerical Characteristics of the Cyclone and Anticyclone and their Synoptic Interpretation. M. Loris-Melikof and A. Sinjagin. *Gerlands Beitr. z. Geophys.* 24. 2–3. *pp.* 121–167, 1929.

The deficit (excess) of air mass in a cyclone (anticyclone) has been obtained by integration between the pressure at the centre and that at the periphery in a region where the pressure distribution is known. The study of these characteristics is stated to lead to empirical laws and to conclusions of practical use in meteorology (*e.g.*, limits and surroundings of a cyclone, junction of two cyclones and the development of one from another). Expressions are obtained for the variation of the deficit of air mass in a cyclone with time. For the earth as a whole the total deficit in all cyclones is only 2 % of the whole air mass. The idea of the centre of gravity of the deficit or excess is introduced, and its track for a moving system investigated. The mean air pressure is calculated for a given region, a segment of the earth, the northern hemisphere, and the whole earth, using an ordinary method and two methods depending on the theory of air deficit, but the results are the same by all methods. The mass of air leaving the cyclone at the upper levels is calculated according to synoptic charts by conclusions depending upon the aerology of the air mass, but this loss is almost entirely compensated by the inflow of air at lower levels. R. S. R.

1764. Mathematical Analysis of Pressure Distribution. G. Dedebant. *Comptes Rendus*, 189. *pp*. 1091–1092, *Dec*. 9, 1929.

Reference is made to simple, variable and stationary noyaux of pressure variations. The last two form a basis of a little understood idea—barometric evolution. Rules are formulated for the noyaux at the birth, growth, decay and death of a pressure perturbation. The stationary noyaux are those of pure evolution, and they retain the limited properties of growing noyaux. The instantaneous barometric evolution is given by the expression $T\left(1 - \frac{\Omega \sin \theta}{\omega}\right)$, where T is the tendency, Ω and ω the speed of travel of noyaux and of isobars, and θ the angle between the isobar and the direction of movement of the noyaux. The lines of pure evolution are those along which the isobar is tangential to the path of the noyaux. The relation of these lines to fronts of discontinuity requires more study, but the double fronts of the Norwegian theory which coincide with troughs of pressure are lines of pure evolution. R. S. R.

1765. Distribution of Atmospheric Polarisation over the Firmament. A. Sinjagin. *Gerlands Beitr. z. Geophys*. 24. 2–3. *pp*. 273–292, 1929.

Establishes an empirical formula which gives a complete and general solution to the problem of the distribution of the directions of the plane of polarisation for the whole celestial vault. The formula is very simple, and allows of a very striking physical interpretation. All previous experimental results can be theoretically obtained by means of an elementary mathematical analysis. The four focal points of the author's system are the neutral points of the vaults, three of which, A_1, B_1 and B_2, have already been discovered. A_2, the fourth, is extremely difficult to obtain experimentally, although the necessary conditions are determined. The formula is true for all points of the heavens and for all the sun's heights, even though variations in the latter cause considerable changes in the distribution of the curves on the celestial vault. A specially constructed mechanical model is briefly described. R. C. F.

1766. Waves and Tides in the Atmosphere. G. I. Taylor. *Roy. Soc., Proc*. 126. *pp*. 169–183, *Dec*. 2, 1929.

Former calculations of the speed of long waves in the atmosphere involved uncertainties regarding the temperature distribution and the equivalent depth (h) of an ocean of uniform density and depth having the same periods as the atmosphere. The author determined the velocity of waves in an atmosphere decreasing at a uniform rate to a certain height and then constant at all heights. The results are applied to the Krakatau wave, and differ by only 2 %, whereas if the semi-diurnal pressure wave were due to resonance the difference should be 14 %. The value of h calculated from the measured velocity of the Krakatau wave, for isothermal changes, is 25,300 ft., while the observed semi-diurnal pressure period of 11 hours 56 minutes gives $h = 25{,}960$ ft. The shape of the Krakatau wave leads to an easterly wind in the tropics with a maximum velocity of 13 ft./sec. near the equator, and a westerly wind with a maximum velocity of 31 ft./sec. near latitude 57° N. and S., conditions very like those found in practice. This shape also shows that h is not more than 5 % less at the poles than at the equator. R. S. R.

1767. Tides in Oceans on a Rotating Globe. Part III. G. R. Goldsbrough and D. C. Colborne. *Roy. Soc., Proc.* 126. *pp.* 1–15, *Dec.* 2, 1929.

In Part I [see Abstract 1194 (1928)] a method was described by which solutions of the general dynamical equations of the tides could be obtained which were appropriate to an ocean on a rotating globe bounded by vertical cliffs along two meridians of longitude. Part II [see Abstract 1467 (1929)] continued the investigation, and the present paper applies the method to an ocean of uniform depth, 12,700 ft., bounded by two meridians 60° apart. Such an ocean would fairly represent the Atlantic Ocean if it were completely land-locked, instead of being quite open to the Southern Ocean at one end and partially open at the other. The particular tide considered is the lunar semi-diurnal tide, but the forms of the co-tidal lines obtained are very different from those of the Atlantic Ocean based upon observations. Further research is, therefore, required. **Erratum,** *ibid.* p. 728, March 3, 1930. H. H. Ho.

1768. Dynamical Tides of an Ocean between Two Parallels. Law of Depth for any Latitude and Longitude. Arrangement of Calculations. M. Brillouin. *Comptes Rendus,* 189. *pp.* 957–960, *Dec.* 2, 1929.

The paper forms a development of earlier analysis [see Abstracts 3501 (1929) and 83 (1930)]. Expressions are obtained for the bottom and free surface of the ocean and for polar caps and continents which involve functions determining completely the total potential in the interior of the ocean and as a consequence the pressure and component velocities in three directions at right angles, and also the expression below the surface of reference. R. S. R.

1769. Dynamical Tides of an Ocean between Two Parallels. Simultaneous Normalisation. M. Brillouin. *Comptes Rendus,* 189. *pp.* 1216–1219, *Dec.* 30, 1929.

The author employs the expressions obtained in an earlier paper [see preceding Abstract] by developing the complex terms to give six simultaneous equations to form the two complex functions. All the equations relate to a surface of reference R, where $\omega_0^2 = R^2 - z^2$, and depend only on z. Such a group of equations exists for each term of longitude. The expressions are applied to the cases of diurnal and semi-diurnal waves. R. S. R.

1770. Experimental Proof of Seismometer Theory. G. Reutlinger. *Gerlands Beitr. z. Geophys.* 24. 2–3. *pp.* 168–240, 1929.

The general theory is first examined and equations are established which are independent of the amount of damping for periodic or non-periodic motion. The theory is then applied and the general construction considered for (1) Zeissig's horizontal vibrograph, (2) vertical vibrographs, devised by (i) Zeissig and Reutlinger using optical magnification, (ii) Schenk-Lehr, (iii) Geiger, (iv) Reutlinger, and (v) Sauer. Observations are made of the true oscillations and frequency, damping and frictional forces and the dynamical law found and compared with theory. The tests show that the instruments agree more or less well with theory, and the

agreement is better when friction at the bearings and the stylus is decreased. Electro-optical means are recommended if large magnification is required.
R. S. R.

1771. Indications from Diagrams of Distant Earthquakes. V. Conrad. *Gerlands Beitr. z. Geophys.* 24. 4. *pp.* 353–362, 1929.

Measurements were made at Vienna of the time of arrival and phases of the seismic waves associated with the New Zealand earthquake of June 16, 1929. It is shown that with the help of a simple numerical method of approximation it is possible to find an epicentral distance which gives the best agreement between the time of arrival observed in the diagram and those calculated by Gutenberg from the Frankfurt curves. This agreement helps to confirm the accuracy of the assumptions made regarding the constitution of the interior of the earth, which are taken as the bases of the calculations of some time-distance curves, and to fix the path and velocity of the waves. R. S. R.

1772. 42-Minute Period in Frequency of After-Shocks of Earthquakes. C. Davison. *Phil. Mag.* 8. *pp.* 801–812, *Dec.*, 1929. *Supplement.*

The time taken by an earthquake wave to travel from the origin to its antipodes is 21 min. It consequently returns to the origin after 42 min. The first return shock, due to partial return of the dislocated masses to their original position, should therefore occur about 21 min. after the original earthquake; the first shock of character similar to the original shock (repetition shock) about 42 min. thereafter, and after-shocks of each character at regular intervals of 42 min. This theory has been tested by an examination of the after-shocks of eleven earthquakes, and distinct evidence in support is found. It appears probable that at first return shocks predominate, and later repetition shocks, with a confused interval in which little periodicity is discernible. This throbbing of the earth appears to continue for as much as two months after a large earthquake, so that in view of the number of earthquakes throughout the globe the earth is probably never really at rest. [See also Abstract 743 (1929).] C. A. S.

1773. Zones of Weakness in the Earth's Crust. W. Bowie. *Science*, 70. *pp.* 589–592, *Dec.* 20, 1929.

Areas of intense sedimentation are in the neighbourhood of areas of intense erosion; isostasy requires a steady depression of the former and rise of the latter, with corresponding movements of (heavier) subcrustal material. Temperature-gradient considerations point to such an eroded area being a zone of weakness, which is inconsistent with the fact that regions of elevation are frequently regions of recent sedimentation. The contraction theory of the origin of mountains is inconsistent with isostasy, and most improbable, as it assumes the buckling over small areas of a skin only some five miles thick as a consequence of forces acting over thousands of miles. It seems, therefore, that there are no zones of weakness as required by this theory, but that uplift is due to local vertical forces. These acting irregularly as erosion occurs cause the horizontal movements which the contraction theory was devised to explain. C. A. S.

1774. Displacement Independent of Dilatation and Rotation in a Solid Body. K. Sezawa and G. Nishimura. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 389–416, *Dec.*, 1929. *In English.*

Expressions are obtained mathematically for the elastic deformation for (1) the case of spherical heterogeneity, (2) a spherical body subjected to normal pressures of any distribution, (3) spheroidal conditions, and (4) an elastic cylinder. It is shown that the deformation of a solid elastic body is composed of dilatation, rotation and another component neither dilatational nor rotational, the first two components being connected both in type and magnitude, while the third has an independent arbitrary constant factor. A new method of dealing with plasticity is developed. The results are applied to the problems of earth movements. [See also Abstract 2394 (1929).] R. S. R.

1775. Propagation of Love Waves on a Spherical Surface and Allied Problems. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 437–455, *Dec.*, 1929. *In English.*

The author applies the methods previously applied to Rayleigh waves [see Abstracts 15 and 2389 (1929)] to the case of Love waves of non-uniform azimuthal distribution on a spherical surface, dealing separately with the cases where the origin of disturbance is at a greater and at a lesser depth. Various conclusions are deduced, amongst them that the velocity of propagation of such waves is the same on a spherical as on a plane surface.

C. A. S.

1776. Time Variation of the Second Space Derivatives of the Gravitational Potential. C. Tsuboi. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 457–466, *Dec.*, 1929. *In English.*

Small changes in the intensity of gravity are hard to measure, but the second space derivative of the gravitational potential can be found with considerable accuracy. An extremely sensitive type of torsion balance was used to obtain continuous measurements. A horizontal beam was supported at its centre by a fine fibre and equal spherical masses loaded at the ends of the rod, while optical means were used to magnify the movement of the system. Equilibrium is obtained between the torsional moment due to the slight curvature of the gravitational equipotential surfaces and that due to rigidity of the fibre. The fibre, beam and support are made from vitreous silica. The theory of the method is given, and examples of the records are shown. The minor fluctuations are ascribed partly to variations in the underground water level, partly to additional loading in the building when more people are present, while some features are at present unexplained. R. S. R.

1777. Pre-Seismic Earth Tilting Observed at Mt. Tukuba. W. Inouye and T. Sugiyama. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 457–459, *Dec.*, 1929. *In English.*

Observations were made during nearly two years at a station about half-way up Mt. Tukuba with a pair of all-silica tiltometers and minor irregularities were smoothed out for the two components to give a resultant vector diagram. The earth tiltings exhibit a secular variation disturbed several times by stormy perturbations. Earthquakes generally occurred when the secular change of earth tiltings had undergone irregular fluctuations of comparatively short period. The direction of oscillation is apparently related to the geological structure of the locality. Some pre-seismic earth tiltings exhibit a period similar to that of the fortnightly tides, while they were more or less pronounced a month or more before, and ended almost simultaneously with, the occurrence of earthquakes.

R. S. R.

1778. Pre-Seismic Earth Tilting and Mechanism of Occurrence of the Kii Earthquake of July 4, 1929. A. Imamura and T. Kodaira. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 460–462, *Dec.*, 1929. *In English.*

Seismometric observations for this earthquake are given and the position of the epicentre and focal depth calculated. The probable earth movements at the time are discussed. Abnormal earth tilting commenced on June 20 and lasted until July 3, and this is considered to be a precursor of an earthquake. R. S. R.

1779. Measurements of the Solar Constant. A. Amerio, O. de Pasquale and V. Ricca. *Accad. Sci. Torino, Atti,* 64. 9*a*–10*a*. *pp.* 159–187, 1928–1929.

The results are given of a long series of observations with the object of determining the solar constant, carried out in the years 1921, 1922 and 1923 on the Aspromonte at Polsi at a height of 900 m., and at Montalto at 1958 m. above sea-level. J. J. S.

1780. Effect of an Exterior Gravitational Field on Motions in the Solar System. H. Mineur. *Comptes Rendus,* 189. *pp.* 1061–1063, *Dec.* 9. 1929.

The effect of the gravitational field of our stellar universe upon the Keplerian motions of the planets has been investigated. It appears that the maximum perturbations, which are those of Neptune, only amount to a few hundredths of a second of arc, and are quite imperceptible. On computing the galactic coordinates for the poles of orbits of the eight principal planets, it is found that all the longitudes differ but little from 243°, which is the longitude of the centre of our local cluster, and the centre of rotation of the neighbouring stars. M. A. E.

1781. Results obtained during the (Solar) Eclipse of May 9, 1929, by the Party sent out by Strasbourg Observatory to Poulo Condore. A. Danjon. *Comptes Rendus,* 189. *pp.* 1190–1192, *Dec.* 23. 1929.

The solar corona was satisfactorily photographed during the eclipse. Cloudy conditions during totality make it doubtful as to whether the plates can be utilised for the determination of the Einstein shift of stellar positions. J. S. G. T.

1782. Central Intensities of some Absorption Lines in the Solar Spectrum. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 89. *pp.* 170–186, *Dec.,* 1929.

Theoretical formulæ for intensities inside Fraunhofer lines have been given by Schuster, Milne and Eddington. Schuster considers only one kind of absorption, Milne takes also into account collisions between the atoms and shows that these appear as "true" absorption, Eddington further adds ordinary continuous absorption and shows that the different kinds of absorption affect radiation in different ways. By applying H. A. Wilson's formula for the coefficient of the scattering to the centre of the K line in the sun, it is found that the Schuster and Milne atmospheres give results which are out of agreement with observations of the central intensities, but Eddington's results are in agreement, and it appears that the high central intensities are due to the effect of collisions. An upper layer in which no collisions occur implies that slightly higher pressures must be attributed to the lower layer, and these are in good agreement with those found by Milne from other considerations. Similar results are given by the principal lines of ionised barium. M. A. E.

1783. Normal Wave-Lengths of the Calcium Lines H and K, and the Relativity Shift of these Lines in the Prominences and Chromosphere. J. Evershed. *Roy. Astron. Soc., M.N.* 89. *pp.* 186–190, *Dec.*, 1929.

The wave-lengths of H and K in the arc in air, referred to standard iron lines, were determined by St. John as 3968·476 and 3933·667 respectively; but a new series of measures by the writer gives 3968·470 and 3933·663. When this difference is taken into account the two sets of measures of the relativity shift in prominence spectra which were made in 1927 and in 1929 are brought into agreement, since the first were derived from iron lines, assuming St. John's values of the calcium lines, and the second from a direct comparison between the solar and terrestrial calcium lines. Measures are now added of the shift of these lines in the chromosphere at the sun's limb, and they agree well with the prominence result. There is an excess of about + 0·007 Å. over the Einstein effect, for both prominences and chromosphere; and any explanation of the cause of this discrepancy which might apply to the conditions in the chromosphere must be equally applicable in the region of the prominences altogether outside the sun's atmosphere. M. A. E.

1784. Spectrohelioscope and its Work. Part I. G. E. Hale. *Mt. Wilson Observat. Contrib. No.* 388. *Astrophys. J.* 70. *pp.* 265–311, *Dec.*, 1929.

The spectrohelioscope permits the visual observation and analysis of the forms and motions of prominences at the sun's limb and of bright and dark flocculi on the disc. The principle of the spectrohelioscope was first suggested by Janssen in 1868, and successfully tried by Young in 1870 for observing the forms of prominences projecting beyond the limb, but was discarded by him when Zöllner and Huggins adopted a spectroscope with widened slit for this purpose. The spectrohelioscope was developed in 1924–1929 by Hale, who applied high dispersion to reveal flocculi on the disc and a "line-shifter" to vary the wave-length of the incident light during observation. The inexpensive instruments described in this article, which comprise a horizontal cœlostat telescope and spectrohelioscope, are suitable for a wide variety of observations. Two oscillating slits of easily variable amplitude or a pair of square prisms (Anderson's design) rotating before fixed slits may be used to give the monochromatic image of a portion of the sun, usually with the $H\alpha$ line. The adjustments of the instruments are described in detail. Methods of observing various types of prominences and flocculi, and of analysing their forms and radial velocities, are then explained. Means of using the spectrohelioscope in conjunction with spectrographs or spectroheliographs are also described. AUTHOR.

1785. Excitation Potential in Solar Phenomena. C. E. St. John. *Mt. Wilson Observat. Contrib. No.* 390. *Astrophys. J.* 70. *pp.* 319–330, *Dec.*, 1929.

Excitation potential fixes the relative heights of the effective absorbing layers above the photosphere. High values of excitation potential require the stronger fields of excitation obtaining near the photosphere in order to excite the needed number of atoms to the energy-levels of absorption. Low heights above the photosphere of absorbing layers for multiplets with high excitation potential are shown graphically by correlating excitation potential with outflow from spots, heights from flash spectra, red displacement and line intensity. The absorbing layers for intersystem lines of a given excitation potential are nearer the photosphere than those for normal lines of the same excitation potential. The low transition probability for intersystem lines requires the greater abundance of atoms obtaining at the higher pressure near the photosphere. Excitation potential determines: (1) the possibility and relative probability of the occurrence of a line in the sun's spectrum; (2) the relative heights of absorbing layers above the photosphere; (3) in connection with transition probability, the maximum line intensity in a multiplet; and (4) the temperature classification. Small changes in the energy-level of the higher term are associated with profound changes in the character of the lines and furnish the basis for a fundamental classification. AUTHOR.

1786. Theory of Planetary Figures. R. Wavre. *Arch. des. Sciences,* 11. *pp.* 141–144, *Nov.–Dec.,* 1929. *Paper read before the Soc. Phys. et d'Hist. Nat., Nov.,* 1929.

Previous publications by the author have given rigorous and very simple means for the study of planetary figures. In the present paper he expresses his formulæ in forms directly suitable for use in geodesy, by developing them so as to contain only quantities which can be physically measured. [See also Abstract 3515 (1929).] R. C. F.

1787. Three Features of the Lunar Crust. H. G. Tomkins. *Roy. Astron. Soc., M.N.* 89. *p.* 198–201, *Dec.,* 1929.

Describes information obtained from a series of photographs of the lunar surface under various lightings and librations. The most important feature is that of a "flow" with its origin in the Mare Nectaris over an area of about 27,000 sq. miles. The path of this flow is completely described. A system of fissure eruptions proceeding from the crater Kepler constitutes the second feature, whilst the third feature is a bright line or ray from Kepler which divides just before reaching Copernicus. The peculiarities of these latter features are dealt with, and a plan of the fissure eruption is also given. The features appear to indicate an igneous and internal origin, and also give the relative age of some of the lunar formations. R. C. F.

1788. Theory of Meteors. H. B. Maris. *Terr. Mag.* 34. *pp.* 309–316, *Dec.,* 1929.

The energy of impact between a molecule of atmospheric nitrogen and a meteor moving at the rate of 4×10^6 cm. per sec. is sufficient to vaporise 56 molecules of iron from the solid state to a gas at 3000° K., or is equal to the energy of an electron dropped through about 200 volts. It is assumed that the result would be a miniature explosion, which would drive from 10 to 100 molecules out of the main mass of the meteor. The energy of the average meteor is observed to be dissipated within roughly 1·5 sec. after entering the upper atmosphere. As the resistance of the air to the solid mass of the meteor can account for only about 1 % of the total energy loss, and radiation from the surface of the meteor for less than 1 % of the total radiation, most of the energy of the meteor is dissipated and changed to radiant energy by the high energy atoms and molecules which escape from the meteor and communicate their energy to the air by collision with air molecules. The meteor flashes into view when the energy of molecules escaping from it is sufficient to support the radiation of the trail. Impacts between air-molecules in the path of the meteor and escaping molecules prevent an increase in brilliancy as the meteor moves from the height of appearance to denser strata of air. At a height of about 60 to 80 km. a compressed air-cap is formed in front of the meteor, which prevents further direct impacts between the meteor and stationary air-molecules. AUTHOR.

1789. Stark Effect for Determining Comparative Absolute Magnitudes. O. Struve. *Astrophys. J.* 70. *pp.* 237–242, *Nov.*, 1929.

The ratio of intensity of the forbidden helium line λ4470 to that of the permitted line λ4472 is used for the determination of relative absolute magnitudes of B-type stars. The total range of absolute magnitude within a single spectral subdivision is of the order of 3 mag. The star 67 Ophiuchi, of type B5p, is found to be highly luminous; its absolute magnitude is 3·0 mag. brighter than that of 88 γ Pegasi, of type B2, and its distance is estimated at 600 parsecs. This is verified by the fact that 67 Ophiuchi has a fairly strong interstellar line of Ca^+. AUTHOR.

1790. Absorption Band Recorded in Stellar Spectra at λ4200. C. T. Elvey and R. S. Zug. *Astrophys. J.* 70. *pp.* 243–250, *Nov.*, 1929.

The absorption band at λ4200 in the plates of four stars made with the Bruce spectrograph attached to the 40-in. refractor of the Yerkes Observatory is about 120 Å. wide and centred near λ4195. The central depth of the band is 9 % absorption of the continuous spectrum. Observations made of the amount of the selective absorption in the glass of the optical system fully account for the stellar band. The contours of the bands were determined. The crown lens of the 40-in. objective exhibits the weak absorption band at λ4345. It is suggested that a part of the absorption bands near λ3800 in stellar spectra also might be due to the glass. AUTHORS.

1791. New Determination of Spectroscopic and Visual Orbits of 61 μ Orionis. P. Bourgeois. *Astrophys. J.* 70. *pp.* 256–262, *Nov.*, 1929.

New observations obtained this year permit the completion of the set of elements of the spectroscopic binary through a complete period of variation of γ. For 1929·7: $\gamma = +\ 42{\cdot}1$ km./sec. A table is given of ten visual observations of the companion covering the period of time from the discovery in 1914 to 1927. From the velocity-curve of the centre of mass of the spectroscopic binary the following elements were deduced: $\gamma = +\ 43{\cdot}3$ km./sec.; $P = 17{\cdot}5$ years; $e = 0{\cdot}76$; $K = 14{\cdot}9$ km./sec.; $\omega = 43°$; $T = 1911{\cdot}75$; $a \sin i = 850{,}000{,}000$ km.; $(m_1^3 \sin^3 i)/(m + m_1)^2 = 0{\cdot}60$. The visual observations give the following additional elements: $i = +\ 70°$; $\Omega = 39°$; $a = 0''{\cdot}27$; $\omega = 223°$ and a (spec.) $= 900{,}000{,}000$ km.; $m_1^3/(m + m_1)^2 = 0{\cdot}72$. A variation of T was found having a period of 17·5 years. The light-equation is not sufficient to explain this variation. Perturbations in the triple system may be responsible for a part of it.

AUTHOR.

1792. System of U Cephei. G. Viola. *Accad. Lincei, Atti*, 10. *pp.* 508–515, *Nov.* 17, 1929.

The observations on this system are discussed. The medium light curve is given, which shows the following peculiarities: (1) it is asymmetrical with respect to the epoch of minimum; (2) presents oscillations during the phase of totality; (3) the maximum luminosity of the system is not constant. J. J. S.

1793. Relation of Light and Velocity Curves of Variable Stars D. B. McLaughlin. *Astron. J.* 40. *No.* 932. *pp.* 16–18, *Nov.* 27, 1929.

It has been regarded as well established that the light maximum of a Cepheid variable nearly coincides in time with its velocity minimum, while in the case of at least one long-period variable, *o* Ceti, light and velocity maxima occur simultaneously. Yet the relations of period to spectrum class, and of period to amplitude of variation, show that the gap between Cepheids and Mira variables is not profound; and numerous stars are known with intermediate periods of 50 to 150 days. It is here shown that with Cepheids there is a slight lag of velocity minimum behind the time of light maximum, and that this lag bears a definite relation to the length of period. The lag is least with Cepheids whose periods fall between 3 and 17 days, and increases with length of period in such a way that stars like ε Aurigæ, with a period of 150 days, form a connecting-link between Cepheids and Mira variables. Mrazek, in a paper in *Astronomische Nachrichten* 236,281, 1929, where he correlates the light and velocity curves of R Lyræ, finds that this M star has a semi-regular variation in a period which falls within the period limits of the Cepheids, and thus the gap appears to be completely bridged. M. A. E.

1794. Photographic Light-Curves of Cepheid Variables. Part I. First Three Fields of International List. L. V. Robinson. *Harvard Coll. Obs., Bull. No.* 871. *pp.* 1–8, *Dec.*, 1929.

For Cepheid variables there is a close relation between period and form of light-curve. Harvard plates taken since the close of last century supply a wealth of homogeneous data, and an extensive survey of Cepheids has been undertaken, including those of the International List. The elements for ten are here given. M. A. E.

1795. Nature of Wolf–Rayet Emission. C. S. Beals. *Roy. Astron. Soc., M.N.* 89. *pp.* 202–212, *Dec.*, 1929.

From observations and measurements of Wolf–Rayet spectra the author develops a theory of stellar emission which postulates the continuous ejection of high-speed atoms from a star by selective radiation pressure. The theory is shown to be in agreement with the observed data, and logical explanations of the width of the Wolf–Rayet bands, their variation in width with wave-length, the appearance of absorption on the violet edges, and the high intensity of the bands relative to the continuous spectrum, are given. The calculated rate of loss of mass of a star by this mechanism also appears to indicate that it is not sufficiently rapid to invalidate the theory. Finally, there appears good reason to believe that the spectral peculiarities of P. Cygni and of other stars showing the same characteristics may be partly explained by the same theory. If Wolf–Rayet stars are termed giants, then the P. Cygni stars should be considered as supergiants. R. C. F.

1796. Distribution of Double Stars along the Giant Series. E. A. Kreiken. *Roy. Astron. Soc., M.N.* 89. *pp.* 212–225, *Dec.*, 1929.

In order to obtain definite conclusions regarding the distribution of double stars along the giant series, the author considers the possibility of determining the relative frequency of both visual and spectroscopic double stars among the different spectral types of the giant series and the main sequence. Stars brighter than visual magnitude 5·51 only are considered, for with these the necessary knowledge as to the validity of radial velocity and the occurrence of visual double stars is as complete as possible. As spectroscopic doubles, all those pairs are considered for which (*a*) the velocity of the centre of gravity is known, (*b*) a provisional value of the velocity of the centre of gravity has been obtained, and (*c*) the radial velocity is known to be variable. Where the variability of the radial velocity is to be ascribed to internal pulsations, it seems permissible to exclude these stars so that two solutions are given, one in which they are excluded and the other in which they are included. A brief discussion of the results is also given. R. C. F.

1797. Separation Limits of Double Stars and Relative Numbers of Optical and Physical Pairs. R. H. Curtiss. *Roy. Astron. Soc., Canada, J.* 23. *pp.* 423–444, *Dec.*, 1929.

The separation limits which have been considered suitable in searching for double stars by different observers from Herschel to Aitken are here considered. Methods of determining the limits for future work, so as to secure the most fruitful results in increasing our knowledge of physical pairs, especially in the new southern observatories of Africa, are discussed in detail. M. A. E.

1798. Proposed Cycle of Stellar Evolution. H. H. Platt. *Frank. Inst., J.* 208. *pp.* 793–796, *Dec.*, 1929.

It is suggested that the researches of Brush show that certain substances are maintained at a measurably higher temperature than their surroundings by absorption of some exceedingly penetrating form of energy-pervading space, and it is assumed that this absorption takes place in the case of all forms of matter in a variable and lesser degree. It is pointed out that on this assumption two of the great inconsistencies of Nernst's hypothesis can be removed and that it is not inconsistent with the stationary picture of stellar evolution developed by Eddington and Russell, and enables the direction of progressive change to be investigated in the direction of integration. It is necessary to trace the source of this all-pervading energy and it is suggested that some transformation may be taking place in remote interstellar space where the outgoing form of energy, to which matter is impenetrable, is being converted into the returning penetrative form. J. G. H. B.

1799. Distances and Masses of Anagalactic Nebulæ. K. Lundmark. *Arkiv f. Mat., Astron. och Fysik, Stockholm,* 21*a*. 9. [4 *pp.*], *and* 21*a*. 10. [6 *pp.*], 1929. *In English.*

For various reasons it seems permissible to assume that the anagalactic nebulæ are systems of stars having the same general properties as the stars within the Galaxy, especially since the outer portions of several have been resolved into star-like points. These resolved stars must be the most luminous in any nebula, and in a former paper the distances of 29 nebulæ were derived mainly from estimates of the star magnitudes, assuming that they are comparable with the brightest stars of the Galaxy. It then appears that the total magnitude and the linear dimensions of these nebulæ are not constant, but show a considerable dispersion around the mean. If, however, the nebular types of Wolf's system are taken separately, the dispersion is so much less that it seems possible to derive fairly accurate values of distances for all when a good value of the total magnitude has been determined. This has been determined for some 1300 nebulæ, and their distances can be computed in light-years by means of the formulæ, tables and curves which are given. It should be possible also to find the masses of double and multiple nebulæ, since the components must be at the same distances from us, and their mass-ratio must be equal to the ratio of the squared circular velocities measured at the same apparent distance from both nuclei. The application of this method will be difficult, but not impossible, if both spectra can be photographed at such a distance from the nucleus that the rotation velocity can be determined. Objections to this method are discussed, and a rare case is mentioned and illustrated where one nebula in a pair seems to have caused a distortion in the spiral arm of the other. From spectroscopic observations of rotation in single anagalactic nebulæ, the masses and absolute magnitudes are deduced of the Andromeda nebula, Messier 81 and two others. M. A. E.

1800. Milne's Problem of Radiative Equilibrium. M. Bronstein. *Zeits. f. Physik*, 58. 9–10. *pp*. 696–699, 1929.

In Hopf's solution of Milne's integral equation for the distribution of temperature in a medium with plane stratification there occurs a constant factor *k*. The author derives the numerical value of this factor, which is necessary in order to determine the correct flow of radiation, by a strict mathematical method. [See also following Abstract.] H. N. A.

1801. Ratio between Effective Temperature of a Star and that on its Surface. M. Bronstein. *Zeits. f. Physik*, 59. 1–2. *pp*. 144–148, 1929.

Gives a strict mathematical proof, based on Milne's integral equation for equilibrium of radiation, that the relation $T_e = \sqrt{2}T_s/\sqrt[8]{3}$ holds between the effective temperature T_e and the surface temperature T_s. If the value of the effective temperature of the sun, 5741° Abs., derived from Abbot's measurements of the solar constant is adopted, the calculated surface temperature is 4657° Abs. The correctness of the formula depends on the assumptions that the material of the stellar atmosphere emits and absorbs like a "grey body," and that local thermodynamic and not monochromatic radiative equilibrium exists at every point in it. [See also preceding Abstract.] H. N. A.

1802. Localisation of the Mass of the Potential Energy of an Elementary Particle. G. I. Pokrowski. *Zeits. f. Physik*, 58. 9–10. *pp*. 700–705, 1929.

Refers to the author's previous work on the energy relations in the stars, and to a paper on the subject by W. Anderson [see Abstract 3303 (1929)]. Considers the effect of assuming that the mass of the potential energy can be localised in the corresponding mass particles, and draws some conclusions. It is shown that if this assumption is made the electrical charge may alter with the velocity. Suggests experimental methods by means of which the relations deduced from the theory could be investigated. H. N. A.

LIGHT.

1803. Absorption of *d*- and *l*-Tartrates of Copper and their Mixture. T. D. Gheorghiu. *Comptes Rendus,* 189. *pp.* 1260–1261, *Dec.* 30, 1929.

Using the green line of mercury as source of light and the method previously described [see Abstract 144 (1930)], the absorptions of solutions of the same concentration of cupric *d*- and *l*-tartrates and of a mixture of equal quantities of the two have been compared. Those of the *d*- and *l*-tartrates are identical, but the mixed solution exhibits an absorption 19 % greater than either. C. A. S.

1804. Transmission of Wedges of Kathode Sputtered Platinum. H. Kienle and H. Siedentopf. *Zeits. f. Physik,* 58. 11–12. *pp.* 726–729, 1929.

The wedges consisted of platinum sputtered on to a quartz plate (*a*) in steps of increasing density or (*b*) in a strip of continuously increasing density. The spectral transmission curves taken at different average transmissions showed that for transmissions between 5 % and 35 % the departure from " neutrality " was markedly greater than for transmissions greater than 40 % or less than 5 %, for which the wedges were in fact sensibly neutral. W. S. S.

1805. Natural Blue Rock-Salt. K. Przibram. *Akad. Wiss. Wien, Ber.* 138. 2*a.* 9–10. *pp.* 781–797, 1929.

A survey is given of recent investigations of the morphology of blue rock-salt and of its origin. The following morphological elements are presented in natural blue rock-salt: (1) blue cubes, and blue layers parallel to the cubic faces; (2) wide bands bounded by dodecahedral surfaces, and fine layers along these surfaces; (3) irregularly bounded blue regions; (4) colourless patches in the blue regions. It has been established that (1) is to be explained by laminar crystal formation, (2) by pressure action. There were indications that the irregular regions (3) belong to separate crystal individuals themselves irregularly bounded. Partial destruction may occur and filling up with colourless salt. The colourless areas (4) indicate, according to the newer researches, recrystallisation of compressed salt, but diffusion of moisture may also play a part. Investigations of the thermoluminescence of natural blue salt show that the traces of potassium existing in the salt are sufficient to cause colouring by means of their β-rays within geologically permissible periods of time. J. J. S.

1806. Unit Quantities in the Maxwell–Helmholtz Colour Triangle and the Determination of the Saturation of a Colour. I. Runge. *Zeits. f. Instrumentenk.* 50. *pp.* 600–603, *Dec.,* 1929.

In the ordinary treatment of the Maxwell–Helmholtz triangle the quantities of two colours regarded as equal are not equally bright, since their equality simply implies that the sums of the three amounts of fundamental sensations contained in them are equal. White is supposed to contain equal numbers of units of each of the three fundamental sensations, though the brightness of the blue light required to form white is much less than that of the red and green. A new form of triangle is described in which units of equal brightness are employed. It is equilateral, but the white point, instead of falling at its centre, is quite close to the RG′ line and far from the B point. This indicates that the amount of blue in the mixture is small. The spectral curve is shown in the diagram, and for some distance runs very close to the red-green line RG′; and it can be seen that to obtain white from spectral yellow of the wave-length $0 \cdot 573\ \mu$ it is only necessary to mix with it about 1/80 of its brightness of blue, the white point being quite close to the spectrum curve. Shows how the saturation of any colour can easily be determined from the diagram. It is not possible to represent colours in a plane diagram so that the distance between them is a measure of the difference between them. A very complicated space model would be necessary. H. N. A.

1807. Improvement of Nocturnal Vision by Telescopes. F. Löhle. *Zeits. f. Instrumentenk.* 49. *pp.* 595–600, *Dec.*, 1929.

The theory is based on the measurements of Hassenstein and Löhle on the threshold values of vision (foveal and extrafoveal) with the eye adapted for darkness, and using circular luminous discs of different sizes. The theoretical and the experimental results show that it is a mistake to expect the more highly magnifying telescopes always to give better results in this direction than those with smaller magnification. Much depends on the loss of light due to absorption and reflection, and on the extent to which the pupil of the eye is filled. For this reason the Galileo telescope gives better results than prismatic glasses. H. N. A.

1808. Reflection Factors of Thin Silver Films. (Miss) J. Clavier. *Rev. d'Optique*, 8. *pp.* 425–438, *Nov.*, 1929.

Examines the effect of varying the thickness of thin silver films on the reflection factors between the wave-lengths 316 $m\mu$ and 326 $m\mu$. The films examined were chemically deposited on strips of glass or quartz. It is found that a decrease in time of plating up to a certain point produces a definite increase in the reflection factors obtained between the above wave-length limits. Below this limit there appears to be a slight decrease in the reflection factors. The film thickness corresponding to the maximum reflection factors is 31 $m\mu$. Further, as the thickness increases there is a slight displacement of the position of minimum reflection towards the lower wave-lengths. Finally, the lowering of the reflection factors of several silver films after exposure to atmospheric effects is examined, and an attempt is also made to explain the results obtained. [See also Abstract 982 (1930).] R. C. F.

1809. Optical Constants of Carbon in the Infra-Red. E. Litzenberger. *Ann. d. Physik*, 3. 6. *pp.* 800–802, *Dec.* 4, 1929.

The carbon referred to is an arc-lamp carbon for which certain optical constants had already been determined by experiment [see Abstract 513 (1918)]. The reflecting power of the carbon is calculated from theory, and agrees fairly well with the values found by experiment. G. E. A.

1810. Photographic Method of Measuring Refractive Indices. T. M. Lowry and C. B. Allsopp. *Roy. Soc., Proc.* 126. *pp.* 165–169, *Dec.* 2, 1929.

To measure the refractive index of a liquid in the ultra-violet beyond the limits of transmission of light by thick layers of liquid in a hollow prism an interference method was used. A thin film of liquid was enclosed between two half-platinised quartz plates placed between two right-angled quartz prisms with quartz lenses for the optical adjustments. The interference fringes were focussed on the slit of the spectrograph and thence to the photographic plate. The quartz étalon cell was surrounded by a water-jacket to get uniformity of temperature. The refractive index can be found for all wave-lengths over a big range (*e.g.*, to 2900 Å.U. for nicotine) in a few seconds or minutes. Sources of error are discussed. R. S. R.

1811. Circular Dichroism. G. Bruhat. *Rev. d'Optique*, 8. *pp.* 413–424, *Nov.*, 1929.

The author discusses the methods employed and the accuracy attainable in measuring (1) rotation in the case of substances possessing circular dichroism and (2) dichroism with the help of a quarter-wave plate. It is shown how measurements can be made in the general case with an apparatus containing two divided circles and an adjustable quarter-wave plate. He describes an ellipsoidal polarimeter which is distinguished from the ordinary type by having behind the polariser a movable and adjustable quarter-wave plate which does not modify the general aspect. The method of use is explained and it is claimed that dichroism should be measured with it as easily as rotation. [See Abstract 989 (1930).]

R. S. R.

1812. Magnetic and Optical Properties of the Benzene Ring in Aromatic Compounds. S. Bhagavantam. *Roy. Soc., Proc.* 126. *pp.* 143–154, *Dec.* 2, 1929.

A study of the above properties chiefly in hexamethylbenzene crystals. The principal gramme-molecular susceptibilities are -190×10^{-6}, -116×10^{-6} and -105×10^{-6}, and the principal refractive indices are, for 5870 Å., 1·8012, 1·7475 and 1·5032. The dispersion is weak. The directions of maximum susceptibility and minimum polarisation coincide with each other and with the normal to the plane of the benzene ring. In the plane of the ring there is a slight magnetic and optical anisotropy. [See also Abstract 336 (1930).] G. E. A.

1813. Influence of Molecular Form and Anisotropy on the Refractivity and Dielectric Behaviour of Liquids. K. S. Krishnan. *Roy. Soc., Proc.* 126. *pp.* 155–164, *Dec.* 2, 1929.

The theory of the optical and electrical properties of liquids outlined in a paper by Raman and Krishnan [see Abstract 1227 (1928)] is here applied to the case of benzene for which the necessary data are available. The deviations from the Lorentz refraction formula are, according to the theory, the effect jointly of the non-spherical shape of the molecule which results in the local polarisation field being anisotropic, and of the optical anisotropy of the molecule itself. Data on light scattering by benzene and its variation with temperature furnish the constants appearing in the formulæ. The change in the Lorentz refraction " constant " in passing from vapour to liquid, and the effect of temperature and pressure variations on the same " constant," are successfully evaluated numerically, in satisfactory agreement with experiment. The application of the theory to the dielectric behaviour of liquid benzene is equally successful. AUTHOR.

1814. Paramagnetic Rotation of the Plane of Polarisation in Uniaxial Crystals of the Rare Earths. H. A. Kramers. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1176–1189, 1929.

Referring to the work of J. Becquerel, the author develops a theory of the magnetic rotation of the plane of polarisation which takes into account the internal electric field. [See Abstract 990 (1930) and following Abstract.]

G. E. A.

1815. Paramagnetic Rotation of the Plane of Polarisation in Crystals of Tysonite and Xenotime. H. A. Kramers and J. Becquerel. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1190–1198, 1929.

The theory developed in a previous paper [see preceding Abstract] is applied in two cases. With tysonite, the observations are in accordance with the view that rotation is due to ions of cerium. In the case of xenotime, the lattice structure of which is known, it was possible to calculate the approximate electric field round the nuclei of the kations. The rotation is probably due to ions of gadolinium. G. E. A.

1816. Paramagnetic Rotatory Power of Crystals of Xenotime at Very Low Temperatures, and Paramagnetic Saturation. J. Becquerel and W. J. de Haas. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1199–1205, 1929. *Comm. No.* 204*a. from the Phys. Lab., Leiden.*

For a plate of xenotime cut perpendicular to the optic axis, and exposed to temperatures obtainable with liquid helium in a field of over 20,000 gauss, paramagnetic saturation is nearly total. The law of rotation for this crystal is more complicated than those found for tysonite and parisite, and the rotation cannot be represented by the Langevin function. G. E. A.

1817. Experimental Verification of the Theory of Paramagnetic Rotatory Polarisation in Crystals of Xenotime. J. Becquerel, W. J. de Haas and H. A. Kramers. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1206–1211, 1929. *Comm. No.* 204*b. from the Phys. Lab., Leiden.*

The rotations in a magnetic field are expressed, in terms of the saturation rotation, by means of a more complicated formula than that originally used [see Abstract 3312 (1929)]. The most probable value of the active magnetic moment is 7 magnetons, resident in the gadolinium ion. G. E. A.

1818. Effect of Temperature and Solvents on the Rotatory Power of Active Bodies. R. Lucas and (Miss) D. Biquard. *Comptes Rendus,* 189. *pp.* 1077–1079, *Dec.* 9, 1929.

Lucas has proposed the hypothesis that, in cases where no chemical action takes place, the molecules of an active body can exist in different monomolecular configurations, the passage from one to another taking place discontinuously. It follows that substances which have variable rotatory power in different solvents may be expected to show optical activities which vary with the temperature, since change of temperature will also vary the proportions of the different configurations. Observations have been made with several active substances, in different solvents, and at different temperatures, and parallelism has been found to exist between the effects of the solvents and those of change of temperature. H. N. A.

1819. Rotatory Dispersion of Organic Compounds. Potassium Borotartrate. T. M. Lowry. *Chem. Soc., J. pp.* 2853–2858, *Dec.,* 1929.

Descamps' interpretation [see Abstract 1338 (1927)] of Lowry and Austin's views concerning the nature of curves of rotatory dispersion of aqueous solutions of tartaric acid containing an equimolecular quantity or a slight excess of boric acid [see Abstract 1592 (1922)] is criticised. A new potassium borotartrate, KB $(C_4H_4O_6)_2$, is now described, this containing a quadricovalent complex ion like that of the borofluorides, KBF_4. The salt has higher rotatory powers than any previously noted for such solutions and potentiometric titration indicates that the complex acid is comparable in strength with hydrochloric acid, but is decomposed by excess of alkali. T. H. P.

1820. Rotatory Dispersion of Organic Compounds. Validity of Drude's Equation. T. M. Lowry. *Chem. Soc., J. pp.* 2858–2863, *Dec.*, 1929.

Various recent criticisms of the author's applications of Drude's equation for optical rotatory dispersion are discussed. T. H. P.

1821. Influence of Magnetic Field, Walls of Containing Vessel and Mutual Reciprocal Action of the Particles on their Orientation in Fluid Crystals. A. van Wyk. *Ann. d. Physik,* 3. 7. *pp.* 879–933, *Dec.* 18, 1929.

The behaviour of fluid crystalline *p*-azoxyanisol has been observed by means of convergent, monochromatic, plane polarised light, with a variable magnetic field perpendicular to the walls of the containing trough. For each wave-length, and each temperature of the substance, a series of field intensities was found at which, using crossed nicols, a figure was obtained similar to that due to a positive crystal plate cut perpendicular to its axis; for intermediate values of the field intensity the figure became faint and unsymmetrical, and vanished for a certain field intensity. It was shown that this effect was due to the wall, since it only appeared when the trough had been cleaned with caustic soda, and not when sulphuric acid was used, as in Mauguin's experiments, where the axial figure simply grew stronger as the field increased. A theoretical explanation of the whole phenomenon is given, which satisfactorily accounts for the observed details. H. N. A.

1822. Asymmetrical Synthesis and Existence in Solution of Racemic Components. A. Cotton. *Comptes Rendus,* 189. *pp.* 1211–1213, *Dec.* 30, 1929.

The author refers to the results of Werner Kuhn, Braun and Freudenberg on the change of optical rotation with decreasing wave-length and to the differences produced when exposed to right and left-handed circularly polarised light and to the fact that these solutions should show circular dichroism. It is considered that the action may be due to racemic components incompletely dissociated in solution but compensating one another. The contrary view is also asserted, but while true in some cases it is not so in all cases, *e.g.*, a mixture of dextro- and lævo-rotatory solutions of copper tartrate which show a distinct change of colour when mixed. R. S. R.

1823. Kerr Effect, Light Scattering and Molecular Structure. K. L. Wolf, G. Briegleb and H. A. Stuart. *Zeits. f. phys. Chem.* 6. *Abt. B.* 3. *pp.* 163–209, *Dec.*, 1929.

A brief review of modern electrical theories of molecular structure, with particular reference to the information gained from observations of the depolarisation of scattered light, the Herweg effect and the Kerr effect. J. H. A.

1824. Diffraction of Light Diffused from a Striated Surface. V. Ronchi. *N. Cimento,* 6. *pp.* 378–380, *Nov.*, 1929.

A beam of light from a concentrated source was sent back from a plane-reflecting surface covered with circular striæ such as those produced by emery cloth and a turner's wheel. If a screen is placed in the path of the reflected beam a luminous cross appears upon it, which is completely achromatic and whose arms are surrounded by a zone of less luminosity.

with an outline of the characteristic form of the evolute of an ellipse. The author discusses this phenomenon and explains it as similar to those previously found by him [see Abstract 3544 (1929)] and as due to an image formed by a circular network of lines at regular intervals on the reflecting surface. J. J. S.

1825. Combination Fringes. P. S. Pavulan. *N. Cimento*, 6. *pp*. 325–329, *Aug.–Sept.–Oct.*, 1929.

A description is given of the type of combination fringes which are produced by the superposition of two incoherent networks, and the simplest method of obtaining these is explained. The nature of these fringes is not interferential but photometric. They consist in the contrast between a discontinuous zone clear and obscure and a continuous grey. An experimental case is described, obtained with the bi-prism, that may have a double interpretation inasmuch as its nature may be interferential. J. J. S.

1826. Achromatic Quarter- and Half-Wave Plates. C. Gaudefroy. *Comptes Rendus*, 189. *pp*. 1289–1291, *Dec*. 30, 1929.

Quarter- and half-wave plates which give a constant retardation for different wave-lengths, and do not, therefore, show the colours of their plates between crossed nicols, can be constructed by superposing several crystalline plates. Thus a half-wave plate can be constructed by superposing quartz 0·745 mm., calcite 0·038 mm. Since the calcite is too thin to be cut with accuracy, it can be replaced by two plates with crossed axes differing in thickness by 0·038 mm. Experiment shows that these figures are correct. T. M. L.

1827. New Form of Polarising Pile of Plates. S. Pokrowski. *Zeits. f. Instrumentenk*. 49. *pp*. 603–607, *Dec*., 1929.

Shows that good results can be obtained if the successive plates are placed at such a distance from one another that the reflected rays from each plate pass out to the side without striking the next plate, and are absorbed by the black walls of the containing tube. The pile is divided into two halves, the plates in these being inclined in opposite directions to the axis of the tube, and they can be adjusted simultaneously for angle by moving a rod. The resulting polariser has a number of advantages, one of which is its cheapness. H. N. A.

1828. Theory of Zone Plate Derived from Voigt's Integral. C. T. Lane. *Canad. J. of Research*, 2. *pp*. 26–30, *Jan*., 1930.

The properties of the zone plate are worked out theoretically, using the method developed by Voigt for diffraction problems. The case treated is the one for which the plate is illuminated by monochromatic plane waves at normal incidence. The various approximations made are clearly indicated, and the results obtained are compared with experimental data.

AUTHOR.

1829. Resolving Power Tests on Microscope Objectives used with Ultra-Violet Radiation. B. K. Johnson. *Phys. Soc., Proc.* 42. *pp*. 16–27, *Dec*. 16, 1929.

The work described was conducted with the view of determining the extent to which the increased resolving power which should be obtainable by the use of ultra-violet radiation instead of visible light is realisable with modern microscope object-glasses, computed for use with ultra-violet radiation. The method, which provides a quantitative rather than a qualitative test on an objective, was first developed for visual lenses, and has now been adapted for use with ultra-violet objectives. An object of known regular structure and of variable interval is produced by projecting in the object-plane of the lens under test a reduced image of a grating, the apparent line separation of which is varied by rotation of the latter; thus the line interval can be determined when resolution just ceases. The results show that the fused quartz monochromatic object-glass of numerical aperture 0·35, computed for and used with radiation of wave-length 0·275 μ, gives nearly twice the resolving power of a lens of similar aperture computed for and used with light of wave-length 0·51 μ; while the fused quartz monochromatic lens of numerical aperture 1·2 has a resolving power 70 % higher than that of a well-corrected object-glass of the same numerical aperture when used with light of wave-length 0·51 μ. AUTHOR.

1830. Plane Grating Spectroscope with Wave-Length Drum. E. Haschek. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 7. *pp*. 525–528, 1929.

Briefly describes the theory and construction of a plane-grating, auto-collimating spectroscope in which wave-length adjustments are simply and easily made. The variable slit of the auto-collimating telescope is illuminated from each side of the instrument, the rays passing through condenser lenses on to small openings in the sides of the telescope tube, and thence through right-angle prisms on to the slit. After passing through the objective, the pencil of rays falls on to the plane grating, which is arranged to be slightly variable along the telescope axis. This displacement is obtained by means of an arm, one end of which is connected to the grating table, whilst the other end is fixed to a nut made to traverse the wave-length scale by rotation of a small handwheel. The wave-length scale gives the thousands and hundreds of the wave-length in Ångström units, whilst the tens and units are read off from an engraved scale on the handwheel. Both the first- and second-order spectra wave-lengths are obtainable in this manner. R. C. F.

1831. Breithaupt's Double Image Tachymeter. W. Uhink. *Zeits. f. Instrumentenk.* 49. *pp*. 581–595, *Dec*., 1929.

As in other recent double-image tachymeters for geodetic measurements a horizontal staff is employed, so as to avoid errors due to unequal atmospheric refraction of the two beams from two points on a vertical staff, owing to the fact that one of them is at a higher level than the other. When a thin glass prism is placed before one half of the theodolite objective, in order to bring the images of two portions of the staff together, the effect is due to the refractive index of the prism, and this depends to some extent on the temperature and pressure of the air. In the Breithaupt instrument two rhombic totally reflecting prisms are made use of, which are placed side by side in front of the theodolite objective, so that the images of a scale on the lower part of the staff and of a vernier scale above it appear more or less shifted with regard to one another in the field of view of the telescope. Matters are so arranged that it is possible to read off on the main scale by means of the vernier the distance from the theodolite axis to the staff, a final adjustment of the reading being possible by means of a micrometer adjustment of the angle between the two prisms. A special optical device consisting of a biprism placed in the image plane of the telescope enables the two images to be produced with perfect clearness one above the other, without any mutual confusion at the line which divides them. A table showing results obtained proves that the instrument is as accurate as others of its kind, and in some respects more so. It is often possible to fit the device to older instruments. H. N. A.

1832. View-Finders for Photographic Apparatus. K. Fischer. *Zeits. f. Instrumentenk.* 49. *pp.* 607–618, *Dec.*, 1929.

Considers the different possibilities for designing view-finders for photographic apparatus, so that they can be used simultaneously for final focussing. There are advantages in using finder objectives of simple construction of the same focal length as the camera objective, and throwing an image on a sheet of ground glass; this image should be magnified about three times by the eye-piece. Small differences between the focal lengths can be corrected for by slightly shifting the ground glass. Points out the disadvantages connected with the use of a ground-glass screen, and considers the possibility of dispensing with it and using a small astronomical telescope as view-finder and focusser. The difficulty is to keep the eye focussed for the same distance, say, for infinity; this is particularly difficult when a moving object is being photographed. A so-called net micrometer placed at the focus of the eye-piece helps to keep the eye focussed on infinity. If the total magnification of the telescope is made unity the object may be viewed through the telescope with one eye, and directly with the other; since the two eyes are accustomed to work together they will continue focussed on the distant object, and the telescope objective will be moved so as to form an image at the focus of the eye-piece. The objective must be mechanically connected to the camera objective so that the latter is simultaneously focussed. H. N. A.

1833. Two Methods for Examining Photographic Plates. O. Oldenberg. *Zeits. f. Physik,* 58. 11–12. *pp.* 722–725, 1929.

Two methods are described for discriminating between a very weak photographic impression and the density changes arising from the granular structure of the plate. In one a number of enlargements are made, exactly superposed, and a contact copy made from the pack of negatives so obtained. The true impression is reinforced in each enlargement, whilst irregularities due to grain structure are evened out. In the second, subjective, method, two independent photographs are obtained and viewed one with each eye, as in a stereoscope. W. S. S.

1834. Validity of the Einstein Equivalent Law for Sensitised and Non-Sensitised Plates. J. Eggert and W. Noddack. *Zeits. f. Physik,* 58. 11–12. *pp.* 861–862, 1929.

Briefly discusses a publication by Schmidt and Pretschner [see Abstract 1012 (1930)], in the light of the quantum gain of the various silver halides, either with or without gelatin, under various conditions. It is shown that Schmidt and Pretschner overlooked the fact that the mass of sodium thiosulphate in the gelatin is dependent on the treatment the gelatin has undergone, and in the authors' previous results this quantity was small enough to be neglected. Results yet to be published indicate that certain of the conclusions of Schmidt and Pretschner are erroneous. R. C. F.

1835. Action of Chromic Acid on the Sensitivity of Solarised Silver Bromide Plates. A. P. H. Trivelli and R. P. Loveland. *Frank. Inst., J.* 208. *pp.* 731–766, *Dec.*, 1929. *Kodak Research Lab. Comm. No.* 400.

From a discussion of results published by different authors it is shown that the action of chromic acid on the sensitivity of photographic plates must be regarded as one of a complex nature. It can be resolved into (*a*) a very slow reaction on the silver halide, (*b*) an action on the silver and on the silver sulphide of the sensitivity specks with different reaction velocities, and (*c*) an action which produces sensitivity by forming a sensitiser out of the gelatin. Prolonged action, however, destroys this sensitivity. The results are described of an investigation on the abnormal action in the over-exposure region of a pure silver bromide emulsion after chromic-acid treatment. Desensitising curves obtained show marked irregularities in the over-exposure region, which, however, disappear if the curves are derived from silver weights instead of densities. These irregularities are caused by increasing silver weights in relation to decreasing densities in the first reversal of the solarisation of the untreated emulsion. After the chromic-acid treatment the grains of the emulsion develop in the usual way—that is, with silver weights approximately proportional to the densities. Finally, an explanation of the chromic-acid sensitisation in the over-exposure region is submitted, based on the concentration speck theory. R. C. F.

1836. Turbidity, Particularly with Regard to the Photographic Industry. F. C. Toy, E. R. Davies, B. H. Crawford and B. Farrow. *Zeits. f. wiss. Phot.* 27. *pp.* 193–235, *Dec.*, 1929.

After a brief historical survey of the subject, with special reference to the previous erroneous use of the term "turbidity," the authors deal fully with the physical properties and measurement of turbidity, particularly considering its importance in the photographic industry. The general theory of apparatus for the measurement of turbidity is dealt with in detail, as is the effect of the factor k, this factor being proportional to the Fechner fraction $\delta B/B$. Photographic methods of measurement are next considered, and causes of the variation of the value of "k" measured photographically are examined. An exact definition of the turbidity visually measured being given, the means of eliminating personal factors in the estimation of the covering power are discussed. Next, the special requirements of photography, such as the use of the covering power, are considered, after which the use of turbidity as the standard of measurement of the state of dispersivity and other optical criteria are examined. The use of an optical constant β of a dispersive system as the criterion of its dispersive condition is then suggested, and the probable relation between β and the size of the nucleus is then theoretically developed. The method utilised for the measurement of the density of undiverted light after passing through a dispersive system and the general conclusions from the results next receive consideration, and the connection between this density and the mass, is obtained. Finally, the connection of β with the wave-length and surface peculiarities is given. R. C. F.

1837. Eberhard Effect and its Importance for Photographic Photometry. N. Walenkov. *Zeits. f. wiss. Phot.* 27. *pp.* 236–267, *Dec.*, 1929.

Gives the results of a careful examination of Eberhard's "surround effect," obtaining its connection with the time of exposure "E," with the size of silver-bromide grains, with the concentration of the silver bromide in the emulsion, and with the thinkness of the light-sensitive layer. The effects of the development and fixing processes, as well as the kind of illumination, are also given. It is found that decreasing the sharpness of the image reduces the effect considerably, and with very large pictures the effect is definitely an edge effect. With pictures 3·0 mm. in diameter the effect reaches the centre, and decreasing this size gives an overlap. The shape of the image does not affect the "surround effect." Fine-grained plates are shown to be free from this effect, and this freedom is not influenced by the thickness of the light-sensitive layer, the concentration of the silver bromide in the emulsion or the wave-length of the affecting radiation. Generally, with increase of grain size the "surround effect" increases, and with coarse-grain emulsions the thickness also plays a small part. No effect can be observed with Röntgen rays; metol-hydrokinone developer used with potassium-bromide solution and iron oxalate developer show no noticeable differences. It is further unconnected with the intensity of the affecting illumination, but increase in exposure time does at first produce a variation. The results show that for astrophotometry and spectrophotometry, owing to lack of sharp images, variations produced by this effect are negligible. R. C. F.

1838. Photochemical Reduction and Oxidation Processes. A. Steigmann. *Zeits. f. wiss. Phot.* 27. *pp.* 268–272, *Dec.*, 1929.

Continues the discussion of this subject on the basis of electron emission [see Abstract 582 (1930)], considering the reasons why the chromophores, such as anthrachinone, or dyes containing these chromophores, such as atnhrachinone dyes, can be made light-fast. It is suggested than any light sensitivity increase is due either to a more or less strong electron protection, as with desensitisation, or, as with light-fast dyes in which no sensitisation power can be observed, to the firm fixation of an electron activation by the absorbed light energy. R. C. F.

1839. Brightness Distribution in Optical Images. A. C. Hardy. *Frank. Inst., J.* 208. *pp.* 773–791, *Dec.*, 1929.

Gives a theoretical treatment of the problem of finding the illumination at any point in the image of an object of given brightness, the image being supposed formed by an optical system which obeys the sine condition. Two kinds of objects are considered, *viz.*, (*a*) the extended surface obeying Lambert's diffusion law and (*b*) the point source. The effect of apertures is described and an expression is found for the illumination of that point of the image which lies on the axis of the optical system. An approximate solution is given for the much more difficult case when the image lies off the axis. The results obtained are applied to certain practical cases. For instance, the relation between brightness, resolving power and magnification in a telescope is dealt with. The optical system used for producing sound records on motion picture films is also described. One useful rule enunciated is that the illumination at any point on the axis of an optical system is the product of the brightness of the source and the solid angle subtended by the exit pupil at that point. The brightness is expressed in candles per unit area and the illumination in lumens per unit area: losses within the optical system are neglected. J. W. T. W.

1840. Visual Measurement of Very Low Brightness. J. Dufay and (Miss) R. Schwégler. *Comptes Rendus*, 189. *pp.* 1261–1263, *Dec.* 30, 1929.

Examines experimentally the precision with which it is possible to measure brightness below 10^{-6} candle/cm.^{2}. The results show that the visual measurement of such low brightnesses necessitates the use of surfaces with a large angular extent. With an apparent diameter of 0·1 radian the mean error for each group of readings only increases slowly with decrease in brightness to 10^{-8} candle/cm.^{2}. A brightness of $2 \cdot 10^{-10}$ candle/cm.^{2} can be measured quite rapidly if the surface has an apparent diameter of 0·25 radian. The lowest perceptible brightness appears to be approximately 10^{-10} candle/cm.^{2}. R. C. F.

1841. Short Duration Phosphorescence in Fused Quartz. H. W. Webb and Helen A. Messenger. *Phys. Rev.* 34. *pp.* 1463–1465, *Dec.* 1, 1929.

The short-lived phosphorescence of fused quartz was found to have a decay constant of approximately 5×10^3 sec^{-1}. The wave-length of the exciting radiation is less than 2270 Å. The phosphorescence radiation is a continuous band extending from 3700 to 4750 Å. with a maximum at 4000 Å. Temperature changes from 20° to 240° C. do not affect this phosphorescence. No phosphorescence of this type was observed in crystalline quartz. AUTHORS.

1842. Fluorescence in Liquids. (Transfer of Activation by Molecular Induction.) J. Perrin and (Miss) Choucroun. *Comptes Rendus,* 189. *pp.* 1213–1216, *Dec.* 30, 1929.

The authors discuss first the conditions under which resonance induction can operate and the results obtained by Perrin in gaseous conditions for Hg and Tl molecules. The authors proved that a similar process operated for phenosafranine solution. At concentrations where deactivation by induction can be neglected, greenish light excites the solution brightly and a little also the blue fluorescence. In this case the phenosafranin molecule instead of becoming inactive only by fluorescence does also give energy to the blue fluorescence. R. S. R.

1843. Proof of Energy Increase in Elementary Processes. H. Beutler and E. Rabinowitsch. *Zeits. f. phys. Chem.* 6. *Abt. B.* 3. *pp.* 233–239, *Dec.,* 1929.

The process of the increase of energy by an activated particle in an elementary process $A^{\times} + A^{\times} = A^{\times\times} + A$ was observed for the case of the activated mercury atom. The method employed was a modified form of the apparatus described in a previous paper [see Abstract 1213 (1929)], and under the variation of the gas present. It was shown that when two activated particles collided the energy of the two was taken by one. The complicated case of chemical luminescence was explained by an experiment with a radiation of 2537 Å. in a mercury resonance vessel containing nitrogen. F. J. B.

1844. Application of the Quantum Theory to the Fluorescence of the Carborundum Detector. O. W. Lossew. *Phys. Zeits.* 30. *pp.* 920–923, *Dec.* 15, 1929.

Photographs of the spectrum from a fluorescent carborundum detector are given. The spectra are continuous, and similar to the white X-ray spectrum in that they have a sharp edge at the short-wave end, the position of which is determined by the contact p.d. according to the relation $n_{\text{max.}} = V_a e/h$, where $n_{\text{max.}}$ is the limiting frequency, V_a the potential difference, and e and h the fundamental charge and Planck's constant respectively. G. E. B.

1845. Extinction of Fluorescence of Dyestuff Solutions. A. W. Banow. *Zeits. f. Physik,* 58. 11–12. *pp.* 811–822, 1929.

Investigation of the influence of the viscosity on the extinction of the fluorescence in very viscous solutions shows that a three hundred-fold increase in the viscosity scarcely affects the extinction curve. In all the observed cases, a rapid extinction of the fluorescence corresponds with a considerable, and a relatively slow extinction with only a slight alteration of the absorption spectrum. Other experiments show that the changes in the absorption spectra caused by increase in the concentration are of similar character to those observed with dyestuffs adsorbed by colloidal particles. It is, therefore, suggested that the changes in absorption spectra at high concentrations are due to forces which are similar to those of adsorption and may be produced by some form of polymerisation of the molecules.

T. H. P.

1846. Absorption Spectra of Water Vapour and Ammonia. R. Mecke. *Phys. Zeits.* 30. *pp.* 907–910, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The absorption spectra in a tube 1·5 in. long have been photographed using a 6·4-in. concave grating and neocyanin plates. A strong band has been found in the case of ammonia at λ7920, and six bands in water vapour between λ10,000 and λ6000. The results are discussed in relation to those of Robertson and Fox and of Barker, and certain molecular structures are proposed. F. S.

1847. Ultra-Violet Absorption of Hydroxyl Ions. H. Ley and B. Ahrends. *Zeits. f. phys. Chem.*, 6. *Abt. B.* 3. *pp.* 240–246, *Dec.*, 1929.

The ultra-violet absorption spectra were determined of sodium hydrate, prepared by the action of sodium on water, and by the interaction of barium hydrate and sodium sulphate, and of the hydrates of calcium and barium. The measurements were carried out in a vacuum apparatus and with a tungsten-silver spark as source of light. It was found that water solutions of the alkali and earth alkali hydroxides gave spectra with an absorption maxima at 186 m., which was characteristic for the hydroxyl ion. The absorption of water underwent a great increase through the formation of the hydroxyl ion. F. J. B.

1848. Quantitative Relationship between Dipole Properties and the Displacement of the Absorption Bands of Homopolar Molecules in Solutions. G. Scheibe and E. Lederle. *Zeits. f. phys. Chem.* 6. *Abt. B.* 3. *pp.* 247–249, *Dec.*, 1929.

A previously found empirical relationship [see Abstract 449 (1929)] between the displacement of the absorption bands of homopolar molecules and the molecular volume of the effective solvent has been established. In addition, a formula has been derived for this displacement in conjunction with the dipole moments and radii of the substances concerned, which contains no arbitrary constants, and which affords reliable results. The temperature dependence of absorption demanded by the formula has been experimentally confirmed. H. H. Ho.

1849. Structure of Ozone Absorption Bands in the Ultra-Violet. M. Lambrey and D. Chalonge. *Gerlands Beitr. z. Geophys.* 24. 1. *pp.* 42–48, 1929.

A form of hydrogen tube cooled by water is described giving a continuous spectrum of great intensity in the region required as far as the Schumann bands. The spectrograph contained two 60° prisms of quartz one right and one left handed. Particulars of the form of the bands are given for different concentrations of ozone, the Huggins and Shaver bands being obtained clearly. Curves illustrate the results for regions of bright, feeble and doubtful bands. In the tables of wave-lengths (I) contains many new details including the telluric bands of Lambert, Déjardin and Chalonge, (II) new bands, and (III) details of the Shaver bands and nine new bands, one at 2665 Å. and eight between 2457 and 2329 Å. where continuous absorption occurs. R. S. R.

1850. Infra-Red Absorption Spectra of Benzene and its Halogen Derivatives. J. F. Daugherty. *Phys. Rev.* 34. *pp.* 1549–1557, *Dec.* 15, 1929.

The infra-red absorption spectra of liquid benzene and its halogen derivatives have been measured from 1·00 μ to 7·50 μ. The near infra-red bands of benzene at 2·17 μ, 2·45 μ and 2·71 μ have been found to agree very well with the results of other observers, and several weak bands have been found which have not been previously noted. The region at 3·30 μ has been studied in detail and different maxima have been found at 3·29 μ, 3·32 μ and 3·44 μ. The region from 5·00 μ to 7·50 μ shows five bands for benzene at 5·06 μ, 5·56 μ, 6·20 μ, 6·74 μ and 7·16 μ. The general absorption of the halogen derivatives is very similar to that for benzene, however; the bands differ somewhat in position of the maxima, and in the weaker bands. The more intense bands in the near infra-red have been classified as overtones or combination bands, and the agreement between calculated and observed bands is satisfactory. AUTHOR.

1851. Raman Effect. A. Dadieu and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 8. *pp.* 607–624 *and* 635–662, *and* 138. 2*a*. 9–10. *pp.* 799–822, 1929.

Continues previous work [see Abstract 193 (1930)] on the Raman effect given by organic compounds and deals with benzene and some derivatives, *viz.*, benzyl alcohol, dimethylaniline, ethyl benzene, benzonitrile, benzyl and benzoyl chlorides, benzophenone, acetophenone and for comparison, acetaldehyde, the spectra being discussed from the oscillation standpoint. The author studies the data of 27 organic substances of great variety for the purpose of elucidating the nature of the C=O and C=C double bonds, and also of chlorine and bromine derivatives. The results of Raman experiments with acetone, zinc acetate, acetonitrile, butylbromide, m-dichlorobenzene, diphenyl, benzoic acid and its methyl and ethyl esters, allyl alcohol, malonic and oxalic acids, are tabulated for the purpose of a quantitative investigation of atomic unions for which the preliminary steps are now taken. H. H. Ho.

1852. Raman Effect in Crystals. H. Nisi. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 407–410, *Nov.*, 1929. *In English.*

In continuation of previous work [see Abstract 2730 (1929)], the effect in beryl, tourmaline, danburite, gypsum and baryte, has been investigated. In the case of the first two, the line corresponding to 3600 cm.$^{-1}$ shift (λ2·8 μ) is attributed to the SiO_4 group. For the last two, the line corresponding to 3404 cm.$^{-1}$ (λ2·94 μ) is attributed to water of crystallisation and that at about 1006 cm.$^{-1}$ to the SO_4 group. F. S.

1853. Raman Effect in Powdered Crystals. R. Bär. *Nature*, 124. *p.* 692, *Nov.* 2, 1929.

The writer finds independently of Menzies [see Abstract 1040 (1930)] that Raman spectra may be obtained using powdered crystals, the scattered unmodified radiation forming a background not sufficiently intense to mask the scattered modified lines. Naphthalene is curiously good in this respect, giving 9 lines quite clearly. Various nitrates were tried, and it was found that the position of the strong lines obtained were the same as for solutions, sodium nitrate excepted. NaCl and NH_4Br gave no lines, nor did solid CO_2. $NaNO_2$ gave one line. A. C. M.

1854. Raman Effect. P. Daure. *Ann. de Physique,* 12. *pp.* 375–441, *Dec.,* 1929.

An account of the nature of the Raman effect and of the results of previous workers is followed by a detailed description of the author's own apparatus and experimental methods. Measurements of the wavelengths and intensities of the Stokes lines of more than thirty liquids and liquefied gases (carbonates, mineral compounds, oxygen compounds) are given. Raman lines may be arranged in three chief groups according to their widths: (1) lines of width less than 1 Å. (crystals); (2) lines of width 1 to 3 Å., which include most lines observed; (3) bands of width 5 to 30 Å. (mineral compounds). A mixture of liquids gives a superposition of the lines of the components, provided chemical combination does not take place. The ratio of the intensities of the Stokes and anti-Stokes lines is found to follow Raman's law. Also the intensity of a line of given frequency is proportional to the fourth power of the exciting frequency. The agreement between the characteristic frequencies of the molecules as determined, on the one hand, by their Raman lines and, on the other, by their infra-red spectra, is good for the hydrogen compounds, but appears to fail for compounds of other elements. It is possible, to some extent, to establish the connection between certain groups of lines of the hydrogen compounds and particular groupings of the atoms in the molecules. G. C. McV.

1855. Raman Effect in Substances of High Melting Point. A. Petrikaln and J. Hochberg. *Zeits. f. Physik,* 59. 1–2. *pp.* 114–116, 1929.

An apparatus, in which the necessary temperature is maintained by the periodic circulation of hot concentrated sulphuric acid, is described for the investigation of the Raman effect exhibited by substances melting at temperatures up to 280° C. The molten eutectic of potassium and sodium nitrates (m.p. 217° C.) exhibits a Raman line for which $\Delta\nu$ has the value 1045 cm.$^{-1}$ approximately, corresponding to a wave-length $9{\cdot}6\,\mu$. J. S. G. T.

1856. Raman Effect in Benzol. R. Bär. *Phys. Zeits.* 30. *pp.* 856–858, Dec. 1, 1929.

A modification of Wood's method of observation [see Abstract 513 (1929)] is described for which greater intensity of illumination is claimed. The method has been used for the investigation of benzol, and the lines observed are discussed in detail. F. S.

1857. Raman Spectra of Some Organic Liquids. J. Ôkubo and H. Hamada. *Tohoku Univ., Sci. Reports,* 18. *pp.* 601–608, *Dec.,* 1929. *In English.*

The liquids tested were pyridine, anisole, hexane and picoline. All of them have many sharp, strong absorbing frequencies in the infra-red region, and the appearance of many scattered radiations from them was to be expected. In the case of pyridine the agreement between the infra-red lines corresponding to the Raman radiations and those directly observed by Coblentz is very good. A comparison of the Raman lines of pyridine with those of picoline shows close similarity corresponding to the similarity of the absorption in the infra-red. This similarity also holds good as between anisole and toluene, and between hexane and pentane. Dadieu and Kohlrausch's conclusions [see Abstract 194 (1930)] respecting the lines from the aromatic C-H and C-C groups are confirmed. H. H. Ho.

1858. Additional Lines in the Secondary Spectrum of Hydrogen. F. C. Connelly. *Phys. Soc., Proc.* 42. *pp.* 28–33, *Dec.* 16, 1929.

The author had measured about 1000 lines in the hydrogen spectrum between λ4735 and λ4018 when the similar work of Gale, Monk and Lee was published in 1928 [see Abstract 1604 (1928)]. The author's list included, however, about 280 lines not given in the prior list, and these are published in the present paper. AUTHOR.

1859. Arc and Spark Radiations from Hydrogen in the Extreme Ultra-Violet. J. Thomson. *Phil. Mag.* 8. *pp.* 977–992, *Dec.*, 1929.

Experiments are described suggesting that the ionising radiations emitted by point discharges in hydrogen come from the gas itself. The way the intensities of these radiations vary with the discharge current is described. It appears that the intensity of the arc radiation from a discharge varies directly as the discharge current, and that the intensity of the spark radiation varies as the square of the current. A rough test of the hypothesis is described in which the light intensity from a neon lamp is compared with the discharge current, and the relationship is found to be linear. A. C. M.

1860. Continuous Hydrogen Spectrum in the Ultra-Violet. Z. Bay and W. Steiner. *Zeits. f. Physik*, 59. 1–2. *pp.* 48–52, 1929.

In continuation of previous work [see Abstracts 635 (1928) and 572 (1929)], a new form of discharge tube is described, made out of Suprax glass and provided with water cooling. The distribution of intensity in the ultra-violet, visible and infra-red regions has been measured with a thermopile, and their dependence upon gas-pressure and current strength have been investigated. F. S.

1861. Continuous Hydrogen Spectrum. Y. Hukumoto. (*Two Papers*). *Tohoku Univ., Sci. Reports*, 18. *pp.* 581–597, *Dec.*, 1929. *In German.*

In the first paper is described an investigation of the spectra excited in a long hydrogen tube, having a different cross-section at each end. One half was 30 mm. broad, the other 6 mm. The hydrogen was contained at a pressure of approximately 10 to 20 mm. Thus the spectrum could be obtained from hydrogen under precisely similar conditions, except for current density. The continuous spectrum was stronger in the spectrum from the wider portion, but the Balmer series was weaker. Increase of current density was accompanied by a decrease in the intensity of the Fulcher bands, relative to that of the rest of the secondary spectrum. It is thought that the catalytic effect of the glass wall of the tube may be partly responsible. The second paper describes the investigation of the distribution of intensity in the continuous spectrum of hydrogen exciting the continuous spectrum in a tube of hydrogen with the electrodeless discharge and using an under-water spark with tungsten electrodes as a comparison source. The variation in the wave-length of the energy radiated in the continuous spectrum is expressed by a curve, for values of the wave-length between 4800 Å. and 2500 Å. The energy at 2500 Å. is about ten times as great as that radiated at 4500 Å. It is possible that the value at 2500 Å is a maximum, the intensity falling off as the Schumann region is approached. A note is appended on the continuous spectrum from the under-water spark. Careful avoidance of the colloidal particles produced by the spark allows the continuous spectrum to be photographed down to at least 1850 Å. A. C. M.

1862. Hydrogen Spectra Obtained by Electronic Collisions in a Mixture of Hydrogen and Mercury Vapour. S. Vencov. *Comptes Rendus,* 189. *pp.* 1073–1075, *Dec.* 9, 1929.

The pressure of the Hg vapour was kept between 1 and 2×10^{-3} mm., that of the H varied between 0·01 and 1 mm. In general the addition of Hg vapour increased the light intensity, so that about one-fifth of the exposure required with pure hydrogen was sufficient. From 10·4 to 25 volts the lines of the arc spectrum of mercury appeared, due to collisions of electrons with normal Hg atoms; at about 20 volts came the three first members of Balmer's series. It appears that Hg atoms excited to the state $2p$ or higher give up their energy in shocks of the second kind to H_2 molecules, which are dissociated. With the pressure of Hg vapour employed the Balmer spectrum was not obtained below 16·5 volts; Duffendack, using a low-tension arc (5·5 volts) in a mixture of H and Hg, got this spectrum at about 14 volts. The author thinks that in D's case the dissociation of H_2 is due solely to very numerous excited Hg atoms and not to electron shock. Describes the behaviour of the secondary spectrum, the continuous spectrum and the behaviour of the spectrum near the line 2537 Å., which does not agree with the interpretation of Schüler and Wolf. Above 50 volts some Hulthén bands (HgH) were identified. H. N. A.

1863. Is the Continuous Spectrum of the Under-Water Spark Temperature Radiation? B. Wrede. *Ann. d. Physik,* 3. 6. *pp.* 823–839, *Dec.* 4, 1929.

Increase in the strength of an under-water spark causes an intensity shift in the continuous spectrum towards shorter wave-lengths if the electrodes used are either zinc, cadmium, copper, lead or tin. A similar shift, although much less evident, is obtained from electrodes of aluminium and magnesium, which give a particularly strong continuous spectra. Detailed measurements of the relative intensity shift have been made for the zinc spark, from which it is shown that the shift follows Wien's law. This demonstrates, therefore, the existence of temperature radiation in the under-water spark. Further, by comparison with the positive crater of the carbon arc, the temperature of the spark has been determined. The results give 7500° K. for a weak, and 10,000° K. for a stronger spark. F. J. W.

1864. Continuous Spectrum of Mercury. W. H. Crew and W. N. Thornton. *J.O.S.A. and R.S.I.* 19. *pp.* 358–366, *Dec.,* 1929.

Details of seven different methods of exciting a mercury lamp are given, the resulting spectra having been recorded with a quartz spectrograph. It is concluded that the conditions which reduce current density in the arc enhance the continuous bands at $\lambda 4500$ and $\lambda 3300$. The origin of the bands is believed to be the molecule of mercury, produced at the distilling surface and readily dissociated by slow-moving ions or electrons. The close agreement of observed and calculated wave-length distribution of intensity increases the likelihood of these bands being truly recombination spectra. F. S.

1865. Continuous Spectra of Flames Containing the Halogens. H. C. Urey and J. R. Bates. *Phys. Rev.* 34. *pp.* 1541–1548, *Dec.* 15, 1929.

According to the Franck-Condon theory for the dissociation of molecules by light, it is also to be expected that two colliding atoms may recombine with the emission of light. This should occur if conditions are arranged so that there are appreciable quantities of the free atoms present. Experiments were carried out with flames of chlorine and hydrogen and hydrogen-oxygen flames containing the halogens. Spectra of these flames are found to be continuous extending into the ultra-violet. It is shown that the violet limits of these spectra are in agreement with the hypothesis that they are due to the recombination of the normal and excited halogen atoms. Calculations show that there are enough collisions of this type in the flames to account for the intensity of the light emitted. AUTHORS.

1866. Ultra-Violet Bands of the Neutral Oxygen Molecule. W. Lochte-Holtgreven and G. H. Dieke. *Ann. d. Physik,* 3. 7. *pp.* 937–977, *Dec.* 18, 1929.

In the first part of this paper an attempt is made to classify all lines hitherto observed of the ultra-violet band spectrum of the neutral oxygen molecule as obtained from a high-potential arc in an oxygen atmosphere. The constants of the lines are calculated and in this connection the work of other investigators is extended. The results are presented in numerous tables. A discussion of the physical significance of the bands is presented, and the fine structure, which up to now has not received attention, is investigated. A. W.

1867. Structure of the Red Lithium Band. K. Wurm. *Zeits. f. Physik,* 59. 1–2. *pp.* 35–41, 1929.

It is shown that the ground state of the red band of Li_2 is identical with that of the blue-green band, and that the simple P- and R- branches are connected with a $^1\Sigma \rightarrow {}^1\Sigma$ electron jump. Six fine structure bands are analysed and the moments of inertia and molecular radii calculated. Considerations of dissociation products show that a molecule in the ground state can give two normal Li atoms, and an excited molecule one normal and one 2P excited atom. F. S.

1868. β- and δ-Bands of NO. R. Schmid. *Zeits. f. Physik,* 59. 1–2. *pp.* 42–47, 1929.

The afterglow of nitrogen was examined in a special discharge tube which permitted the application of a magnetic field. The bands, which lie between 2500–2300 Å. and 2300-2100 Å. respectively, were photographed with a large quartz spectrograph. It is shown that the β-bands are resolved into doublets in the same way as the γ-bands. In the second part of the paper the doublet character of the δ-bands is established and that the ground level is a ^2S level. The term system of the NO molecule is compared with that of the Al atom. F. S.

1869. Band Spectra of Zinc Vapour. H. Volkringer. *Comptes Rendus,* 189. *pp.* 1264–1265, *Dec.* 30, 1929.

Zinc vapour, when heated to redness in a silica tube and excited by an electrodeless discharge, is found to possess a band spectrum. Increasing the temperature of the vapour causes the band heads to move to shorter wave-lengths, and a large number of new rays appear. A table of the wave-lengths of the lines between 2983 Å. and 3282 Å. is given, and it is stated that the bands have a very complex fine structure. The question of the carrier of the band spectrum is also very briefly discussed. R. C. F.

1870. Spectrum of Arsenic in the Extreme Ultra-Violet. P. Queney. *J. de Physique et le Radium,* 10. *pp.* 448–452, *Dec.*, 1929.

In continuation of previous work [see Abstract 173 (1930)] the lines of arsenic from 2500 Å. to 700 Å. are tabulated. The strongest lines of As V and As IV have been classified using the known classifications of Zn, Ga and Ge. F. S.

1871. Perturbations in Band Spectra. Jenny E. Rosenthal and F. A. Jenkins. *Nat. Acad. Sci., Proc.* 15. *pp.* 896–902, *Dec.*, 1929.

In continuation of previous work on the CN-band system [see Abstract 3054 (1929)], the perturbations in the CO Ångstrom bands, $^1S - {}^1P$, are considered. A new analysis of the (O,0) band is given and the results compared with those of Jassé. The perturbations of the (O,1) band are also considered, and it is concluded that the a levels are responsible. F. S.

1872. Intensity Distribution in Fine Structure. L. Goldstein. *J. de Physique et le Radium,* 10. *pp.* 439–447, *Dec.*, 1929.

Intensity of the fine structure lines of hydrogen is calculated from Dirac's relativistic theory. Contrary to experience, theory shows the violet component in the Balmer series to be much more intense than the red component and the same result is found for the Paschen series. The paper is mathematical. F. S.

1873. Hyperfine Structures and Nuclear Moments. H. Schüler and H. Brück. *Zeits. f. Physik,* 58. 11–12. *pp.* 735–741, 1929.

In continuation of the considerations of two previous papers the hyperfine structures of Cd and Tl are further discussed. In the case of Tl the results point to the existence of isotopes; this is confirmed by the atomic weight 204·4, which differs greatly from a whole number. The number of components in the lines 5352 and 2768 differs from that to be expected with a single isotope. Concludes with a general survey of the known nuclear moments, particularly in relation to the effect of alterations in the number of protons and electrons in the nucleus in proceeding from one element to another. H. N. A.

1874. Hyperfine Structure in Singly Ionised Praseodymium. H. E. White. *Phys. Rev.* 34. *pp.* 1397–1403, *Dec.* 1, 1929.

Wave-lengths and frequency separations of the fine-structure components of 173 spectral lines in singly ionised praseodymium are given. Each group of six fine-structure lines has the same general appearance but varies in total intensity and width. In some lines given below the intensities and frequency separations within each group decrease towards the red, while all the rest show similar degradation towards the violet. These fine structures may be accounted for by assigning an angular momentum, $i = (5/2)\ (h/2\pi)$ to the nucleus of the praseodymium atom. This angular momentum space quantised with the total angular momentum of the outside electrons, J, yields for each energy level six components (provided $J \geq 5/2$), the actual separations between which are given by the strength of coupling between i and J. Since a $6p$ electron in the atom of praseodymium is part of the time very close to the nucleus and part of the time outside of all of the other electrons, the strength of coupling for an electron configuration involving a single $6s$ electron should be very much greater than that for a $6s$ electron and still greater than that for a $5d$ or a $4f$ electron. According to the Bohr-Stoner scheme of the building up of the elements one should expect, and the fine structure intervals confirm this, that practically all of the energy levels in Pr II have very large J values. [See also following Abstract.] AUTHOR.

1875. Interpretation of Hyperfine Structure in Spectral Terms. H. E. White. *Phys. Rev.* 34. *pp.* 1404–1410, *Dec.* 1, 1929.

Interpretation of hyperfine structures in cadmium, bismuth and lanthanum. Term analysis of the hyperfine structure of cadmium indicates, as suggested by Schüler and Brück, that the fine structures of λλ5086, 4800 and 4678 are due to isotopes, some with an angular momentum 0 and some with an angular momentum $\frac{1}{2}h/2\pi$. This is verified by the fine-structure $\Delta\nu$'s when each level f is assigned a weight $2f + 1$. The inverted terms indicate a positively charged nuclear spin. Some of the fine-structure terms in bismuth and lanthanum are inverted while others are not. The process of inversion within multiplet terms is shown in diagrams. The data are taken from the work of Back and Goudsmit for Bi, and from Meggers and Burns for La. A possible explanation of term inversion is given. This is based upon the penetration of an s valence electron, since part of the time it is found near the nucleus and part of the time outside all of the other electrons. In this way the penetrating electron acts as a carrier in that it strengthens the coupling between J of the valence electrons and the nuclear spin i. For multiplet terms, which involve an s electron and which show LS coupling, the total fine-structure separations for each term should be proportional to cos Si when cos Ji = 1, provided $J > i$, while at the same time the relative separations within each term should be given by the cos Ji. [See also preceding Abstract.] AUTHOR.

1876. Separations in Hyperfine Structure. S. Goudsmit and R. F. Bacher. *Phys. Rev.* 34. *pp.* 1501–1506, *Dec.* 15, 1929.

The quantum mechanics conception of a spinning electron in an s state makes it probable that its interaction energy with a nuclear moment i is simply proportional to the average of is cos (is). Expressions for this average cosine have been obtained and applied to different examples. In more complicated cases it can only be said that the interaction energy is proportional to ij cos (ij), which makes the interval rule hold for hyperfine structure. AUTHORS.

1877. Zeeman Effect in Doublet Band Spectra. E. L. Hill. *Phys. Rev.* 34. *pp.* 1507–1516, *Dec.* 15, 1929.

A theoretical investigation is given of the Zeeman effect for doublet bands of diatomic molecules which are included in the type forms of Hund's cases (a) and (b). With case (b) as a starting point, using the perturbation theory of the new quantum mechanics, the magnetic terms are first treated as a small correction to the coupling energy between the electron spin and orbital magnetic moments. In the next approximation the terms which lead to a Paschen-Back effect are included. The physical interpretation according to which the term system degenerates into that due to a free spin electron plus that due to a symmetrical top, is discussed briefly in its relation to the experimentally observable patterns. The formal mathematical solution is then given and briefly discussed. AUTHOR.

1878. Zeeman Effect in the MgH Bands. G. M. Almy and F. H. Crawford. *Phys. Rev.* 34. *pp.* 1517–1529, *Dec.* 15, 1929.

The investigation of the Zeeman effect in the MgH $^2\Pi \rightarrow {}^2\Sigma$ bands at 7 field strengths between 5000 and 28,000 gauss is described. The bands were produced by a Mg arc, operating in hydrogen. A powerful magnet, equipped with a Back-box, was used in conjunction with a 21-foot concave grating. With the use of the results obtained by Hill (see preceding Abstract], theoretical patterns for representative lines in the band are plotted. For the higher lines considered only the extreme energy levels ($M = \pm J$) and " zero lines " ($M = 0$) are obtained from which the appearance of the unresolved patterns may be predicted. In general for these lines a no-field doublet consists in the field of a central band filling the no-field interval and two outer components or wings, one on either side. A detailed description of the observable patterns in the band λ5211 and a quantitative comparison with the theory are put in tabular form. The first lines show a fine structure in good numerical agreement with the calculations, while for the higher doublets the unresolved patterns correspond closely to those predicted. In the latter case, a central band practically fills the no-field interval, its intensity increasing with the field. The wings become more widely separated and less intense, approaching the separation $4\Delta\nu_n$ as the Paschen-Back effect begins. Certain observations on intensities are correlated (1) with the distribution of components in the theoretical patterns, (2) with the relative orientations of spin and magnetic field in the two states of the molecule. The most clean-cut observation on intensities fitting in with the theory is the decrease in the intensity of the wings relative to that of the central band as the Paschen-Back effect begins. Then only transitions for which $\Delta M_s = 0$ have an appreciable probability. These give the central band, whereas $|\Delta M_s| = 1$ corresponds to the wings, whose intensity is correspondingly small.

AUTHORS.

1879. Fine Structure and Zeeman Effects in Helium Band Lines. R. S. Mulliken and G. S. Monk. *Phys. Rev.* 34. *pp.* 1530–1540, *Dec.* 15, 1929.

Second and third order grating photographs of helium (λλ6400, 5733, 4546 and others) having the $2^3\Pi$ state as their final electron level show fine structures in the band lines. The $3\Pi \rightarrow 2^3\Sigma$ bands (λλ4650, 4670) show no evidence of fine structures in their lines. The observed results can be completely explained by assuming that each rotational level of the $2^3\Pi$ electron state has a characteristic partially resolved fine structure, but that the fine structures which presumably exist for the other electron states involved ($2^3\Sigma$, $3^3\Sigma$, $4^3\Sigma$, $3^3\Pi$, etc.) are much narrower and completely unresolved in our work. There are two types of fine structures in the $2^3\Pi$ levels, one for the odd K values (A levels), another for the even K values (B levels). The theoretical interpretation of the observed fine structures as partially resolved triplets is discussed. The Zeeman effect of the λ6400 band ($3^3\Sigma \rightarrow 2^3\Pi$) was investigated at three field strengths. In the field, the original fine structures disappear, and the Zeeman patterns which replace them are found to be in excellent agreement with those predicted for a $^1\Sigma \rightarrow {}^1\Pi$ transition. Thus it is evident that the effect of the spin ($S = 1$) which gives rise to the original fine structure is completely overpowered by the external field (Paschen-Back effect). AUTHORS.

1880. Complex 4*d* Terms of the Helium Molecule. E. Fermi. *Accad. Lincei, Atti,* 10. *pp.* 515–517, *Nov.* 17, 1929.

By the theory of perturbations of quantistic mechanics may be calculated for the helium molecule the energy of coupling along the line joining the two nuclei of the molecule and the quantity of motion of the electrons. By this theory the author calculates the differences between the terms $4d\sigma$, $4d\pi$, $4d\delta$ of the complex. The differences between the terms $4d\delta$ and $4d\sigma$ and between $4d\pi$ and $4d\sigma$ as calculated by the theory are 260 and 65. The corresponding experimental values are 300 and 75. The divergence is about 15%. This difference is probably due to the simplifying hypotheses of the theory, and perhaps in good part to the perturbing influence of one of the electrons. [See Abstract 632 (1930).]

J. J. S.

1881. Structure of the Light Quant. W. Anderson. *Zeits. f. Physik,* 58. 11–12. *pp.* 841–857, 1929.

The theory advanced is that a light quant consists of an electric dipole of which the positive and negative charges equal those of the proton and electron respectively. The mass of the dipole is not related to the protonic or electronic mass. The electrostatic energy of the dipole gives it its " rest energy ", which is normally much smaller than the total energy $h\nu$. On collision, however, the dipole distorts and its kinetic energy is transformed to potential energy. The accompanying increase of electric force between the poles of the dipole is then adequate to produce photoelectric effects. A theory of the isolated components of the dipole is also developed, and it is shown that the thin sheet of electric field accompanying one of these particles when travelling at the velocity of light is analogous to the de Broglie material waves. W. S. S.

1882. X-Ray Diffraction in Various Substances, Chiefly Liquids. J. Thibaud and J. J. Trillat. *Comptes Rendus,* 189. *pp.* 751–753, *Nov.* 4, 1929.

The diffraction of X-rays by the discontinuous distribution of a material in a liquid, whereby a halo was formed, was studied. It was found that a second annular ring was formed when the thickness of the layer of the substance studied was fairly thick. For the saturated liquid fatty acids the thickness was 2 mm. The second ring was fainter than the fundamental ring. It was found that the diameter of the fundamental ring did not vary with the applied voltage, but the diameter of the second ring diminished rapidly with it. Voltages of 15, 17·5, 20, 30 and 40 kV were applied, and the variation of the diameter of the ring for nonylic acid was measured at each voltage. F. J. B.

1883. Unit Character of Multiplets. C. E. St. John. *Mt. Wilson Observat. Contrib. No.* 389. *Astrophys. J.* 70. *pp.* 312–318, *Dec.,* 1929.

Nine strong Fe multiplets in the violet with a range of line intensity within the multiplet of 2–40 give a red shift of + 0·0104 Å. for strong and + 0·0100 Å. for weak lines; 4 of medium strength with a range of line intensity of 1–6 give + 0·0077 Å. for strong and + 0·0074 for weak; 8 in the red with a range of line intensity of 1–9 give + 0·0089 for strong and + 0·0087 for weak lines. In a total of 154 lines 73 strong lines give + 0·0094 Å. and 81 weak lines + 0·0092 Å. Lines on the main diagonal of the multiplet diagrams are taken as strong, on the side diagonals as weak. The calculation of theoretical intensities, the calibration of the Rowland scale of intensities, the deduction of the number of atoms per sq. cm. from line contours, and the equal red shift for the lines in a multiplet, whatever their intensity, imply in the sun definite layers of maximum absorption. Lines of mean intensity 6·5 in multiplets of maximum intensity 20–40 are higher by 400 km. than lines of the same intensity in multiplets of maximum intensity 6–7, but owing to photographic errors are measured somewhat lower than the strongest lines in the multiplet. AUTHOR.

1884. Polarisation of X-Radiation. W. Duane. *Nat. Acad. Sci., Proc.* 15. *pp.* 805–815, *Nov.*, 1929.

Description of experiments to test the polarisation of the X-radiation obtained from the collisions of high-speed electrons and mercury-vapour atoms. The polarisation of the radiation in a direction at right angles to the stream of electrons is investigated. The method used is to scatter the primary beam by means of a block of carbon and to measure the intensity of the scattered beam in various directions. This is done by counting the number of photons of the scattered beam absorbed in a chamber filled with argon, using a point-counter. The general (not characteristic) primary X-radiation is found to be largely, but not completely, polarised. If unity is taken to measure the degree of polarisation of a completely polarised beam, then the observed degrees of polarisation range from 0·427 to 0·587. Since the beam is not homogeneous, this must be taken to be the average degree of polarisation of X-rays of different wave-lengths. The density of the mercury vapour influences the degree of polarisation slightly, if at all. G. C. McV.

1885. X-Ray Absorption of Liquids. J. Thibaud and J. J. Trillat. *Comptes Rendus*, 189. *pp.* 907–909, *Nov.* 25, 1929.

The secondary halo observed in X-ray diffraction patterns of liquids has been attributed to the continuous background radiation. As a check the absorption of a number of liquids has been measured using an ebonite cell with cellophane windows, and the observed results for some organic acids are given for the Kα lines of copper and molybdenum. The distribution of continuous radiation at a number of exciting voltages is discussed, and the use of radiation filtered by reflection at a crystal is recommended to prevent the formation of secondary rings. F. S.

1886. K-Absorption Discontinuities of Manganous and Chromate Ions. D. M. Yost. *Phil. Mag.* 8. *pp.* 845–847, *Dec.*, 1929. *Supplement.*

It was found that within the limits of experimental error the absorption discontinuities of manganous and chromate ions in solution have the same wave-lengths as the corresponding ions in crystalline salts. The fine structure of the chromate edge observed in the case of the solid salts is also observed unchanged in the spectra obtained with solutions. The solutions of the salts used were placed in fine quartz capillary tubes. J. J. S.

1887. Compton Effect for Soft X-Rays. R. H. Varian. *J.O.S.A. and R.S.I.* 19. *pp.* 351–357, *Dec.*, 1929.

Spectrograms showing the Compton effect for the K lines of Cu, scattered by carbon and paraffin, were obtained, and the ratio of the intensity of the modified component to the unmodified was determined as a function of the scattering angle. It is shown that the L electrons of carbon make a considerable contribution to the unmodified component. Wentzel's theory of the Compton effect is not easily susceptible to experimental check, and Jauncey's theory does not agree with the present results. F. S.

1888. Efficiency of Production of Fluorescent X-Rays. A. H. Compton. *Phil. Mag.* 8. *pp.* 961–977, *Dec.*, 1929.

A review of previous work shows that agreement exists that the number of quanta of fluorescent X-rays emitted by a radiator is considerably less than the number of quanta it absorbs from the primary beam. But the various values of the efficiency of fluorescence are not consistent. New experiments are made on this point, and the following numbers are found for the "fluorescence yield" (ratio of number of fluorescent K quanta to the number of photoelectrons ejected from the K shell) for the radiators named:—Mo 0·68; Br 0·56; Se 0·54; Ni 0·37. The values are independent of the wave-length of the exciting rays. These numbers agree with Auger's, based on the frequency of occurrence of the compound photoelectric effect, thus indicating that it is this effect which makes the fluorescent yield less than unity. An expression is derived for the relative intensity of two X-ray beams of different wave-length, in terms of the ionisation currents obtained and other factors. A. C. M.

1889. Errors in Use of Gratings with X-Rays due to Divergence of the Radiation. H. E. Stauss. *Phys. Rev.* 34. *pp.* 1601–1604, *Dec.* 15, 1929.

The errors in the measurement of X-ray wave-lengths by means of gratings that are to be expected on account of the divergence of the incident beam are considered in more detail than has been done before. In particular, the displacement of the diffracted line, the displacement of the zero order, or reflected, line, the displacement of the centre of the incident beam relative to the centre of the grating, and the effect of the height of the slits are considered and the expressions for the errors are obtained. These are applied to one of Bearden's spectrograms, and the magnitude of the errors calculated. In this particular case, and apparently in general, the errors are less than other experimental errors. AUTHOR.

1890. Prevention of Contamination of the Antikathode in a Composite X-Ray Tube during Working. H. Seemann, P. Gallitelli and O. Kantorowicz. *Zeits. f. Physik*, 58. 11–12. *pp.* 823–829, 1929.

It has often been stated that the spectrum obtained from an X-ray tube shows not only the spectrum of the antikathode, but also contains lines which belong to the metal of the hot wire and of the focussing arrangement. On the other hand, experiments by F. H. Schneider and others with iron and molybdenum antikathodes show no extraneous lines. The authors investigate the possibility of obtaining pure Röntgen spectra with hot wires of tungsten and molybdenum. A sketch of the apparatus is given with a description of the method of working the tube. To obtain a pure metallic antikathode, it is advisable to deposit electrolytically the required metal on it. It may with advantage be coppered, and this copper layer used as a base on which the metal whose spectrum is desired may be attached. The method used in photographing the spectra is described. T. B.

RADIOACTIVITY.

1891. Atmospheric Radioactivity. G. Aliverti. *Accad. Sci. Torino, Atti*, 64. 7*a*–8*a*. *pp*. 97–103, 1928–1929.

A comparison was made between the radioactivity of the atmosphere at the Col d'Olen (2900 m. above sea-level) and that at Turin (240 m.). The apparatus used was similar to that of Elster and Geitel. A copper wire 15 m. long and 0·5 mm. in diameter was exposed for periods of two hours at a time at a height of about 3 m. above the ground, being kept at a nearly constant negative potential by an electrostatic machine. The mean total activity at Col d'Olen was found to be 250 from measurements on nine normal days. The mean activity at Turin was 60, a little less than a quarter of that at Col d'Olen. J. J. S.

1892. Regularities of Radioactive Disintegration. M. Wolfke. *Phys. Zeits.* 30. *pp*. 899–901, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

Shows mathematically that it is not necessary to assume that the probability at a given instant of the disintegration of any particular atom is independent of its age, and remains constant at all times during its existence; but that the same law of disintegration for a quantity of the substance would result if the atoms were formed originally according to the law of probability, and their after history went on by means of a definite mechanism. The result arrived at is that the probability of disintegration of any atom, from the instant of its formation up to the time T fixed by the conditions under which it was formed, is zero; while at time T it becomes unity, and the atom at once disintegrates. Suggests the possibility of influencing the life of a radioactive element by altering the conditions under which it is produced. H. N. A.

1893. Apparatus for Use in Investigations on Radioactivity. O. Erbacher, K. Philipp and K. Donat. *Phys. Zeits.* 30. *pp*. 913–918, *Dec.* 15, 1929.

Describes apparatus for opening glass tubes, containing radium and mesothorium preparations, inside a glass box covered by a glass lid, so that there is no danger of any of the contents being lost. A ring can be cut round the end of the tube by means of a diamond operated from outside the box, and the end can then be cracked off by means of an electrically-heated platinum wire also inside the box. Details are given of a glass rotating water bath; an air-tight γ-ray electroscope; an α-ray electroscope with auxiliary condenser for use with strong preparations; and apparatus for collecting the active deposits of radium and of thorium from dry preparations giving out a large amount of emanation. H. N. A.

1894. Disappearance of Radon in Quartz Capillaries on Electrodeless Discharge. H. Pettersson. *Akad. Wiss. Wien, Ber.* 138. 2*a*, 9–10. *pp*. 749–753, 1929.

Radon which is subjected to h.f. electrodeless discharge in quartz capillaries disappears almost completely after a short time into the quartz wall, both under and between the external electrodes. The "bound" emanation is partially liberated on heating the quartz tubes to softening temperature. The results are compared to the observations of previous writers of the disappearance of xenon in discharge tubes. W. V. M.

1895. Electrochemical Behaviour of Polonium in Solutions of Varied H-Ion Concentration. Selma Schneidt. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 9–10. *pp*. 755–765, 1929.

1896. Electrochemical Properties of Polonium. F. Joliot. *Comptes Rendus*, 189. *pp*. 986–988, *Dec*. 2, 1929.

Studies the electrochemical deposition of polonium, using different salts and different solvents, causing different critical potentials of deposition at the kathode and at the anode in different cases. It seems probable that the results are due to $Po_{+}O_{+}$ forming a kation with the critical potential + 0·37 volt, to a suboxide or the metallic ion forming a kation with the critical potential + 0·02 volt and to an anion $Po_{-}O_{3-}$ with a critical potential + 1·1 volts. H. N. A.

1897. Output of Heat from Polonium. (Miss) A. Dorabialska. *Comptes Rendus*, 189. *pp*. 988–990, *Dec*. 2, 1929.

Measurements have been made with two polonium sources, one of 3125 e.s.u. deposited on a silver plate, the other of 2607 e.s.u. on a nickel plate, using adiabatic microcalorimeters of copper, nickel, zinc and silver. The results with the silver calorimeter differed from those with the others, and apparently there was some reaction between the polonium and the silver. The mean value of Q, the heat output in calories per hour, deduced for the quantity of polonium in radioactive equilibrium with 1 gm. of radium was 24·0 ± 1·2 %. This is considerably lower than that calculated from the heat output measured for radium and its derivatives. The measurements are regarded as preliminary ones. H. N. A.

1898. Decay Constant of Radium. D. E. Schweidler. *Akad. Wiss. Wien, Ber*. 138. 2*a*, 9–10. *pp*. 743–747, 1929.

The radioactive decay of RaD was measured by a direct method by means of long-continued observations extending over 15½ years on the falling-off of activity. This time is comparable with that of the half-value period. The investigation was made with four preparations of which two were tested on their total radiation and two on $(\beta + \gamma)$ radiation. The mean value found for the half-value period was T = 22·1 years with an accuracy of about 2 %. J. J. S.

1899. Method of Action of the Geiger Counting Chamber. K. Molin. *Arkiv f. Mat., Astron. och Fysik, Stockholm*, 21*a*. 20. [22 pp.]. 1929.

The investigation was carried out with the Mα- and Mβ-lines of tungsten and the ratio of the intensities of these lines was determined. Of a narrow vertical bundle of X-rays of about 7 Å. units wave-length incident in the Geiger chamber only a fraction is used. The vertical extent of the active portion amounts to about 1 mm. The intensity indicated by the Geiger chamber increases with the distance of the point from the slit. With diminishing distance between point and slit the ratio of the intensities of the Mα- and Mβ-lines of tungsten determined by the Geiger method approximates to that obtained by the ionisation method. In consequence of the antikathode absorption the ratio of the intensities of the Mα- and Mβ-lines decreases with increasing antikathode angle, since for tungsten $\mu\beta > \mu\alpha$. The decrease of the intensity ratio for angles from 31° to 46·5°

amounts on the average only to 0·14 % per degree of antikathode angle. A newly constructed Geiger chamber is described. J. J. S.

1900. Radiation Causing the Final Rise in the Absorption Curves of Ra(D + E). G. Fournier and M. Guillot. *Comptes Rendus*, 189. *pp.* 1079–1081, *Dec.* 9, 1929.

By using the ionisation method, with a very sensitive piezoelectric quartz apparatus, the authors have been able to determine the absorption curve in carbon of the radiation from Ra(D + E). In previous measurements there was uncertainty when the superficial mass of the screens was 0·25 gm./cm.^{2}, but it was found possible to measure to about 1·5 gm./cm.^{2}, and a distinct final rise in the curve was observed. This had not previously been found with screens of atomic numbers less than 50. The phenomenon seems to be due to primary γ-radiation from the source, which manifests itself when the β-radiation has been sufficiently attenuated. H. N. A.

1901. Counting of α- and H-Particles by means of a "Multiplication" Counter. H. Fränz. *Phys. Zeits.* 30. *pp.* 810–812; *Disc.*, 812, *Nov.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The experimental difficulties in the counting of α- and H-particles are much increased in the presence of γ- and β-rays. The difficulties have been overcome to a certain extent by Geiger and Klemperer, but for H-particles their very small number per second makes this method very unreliable. The author describes results obtained with an apparatus consisting of a counter filled with hydrogen coupled to a Siemens loop oscillograph with a natural frequency of 2 000 periods per second. Owing to the low sensitivity of this instrument it is necessary to use a three-valve capacity-coupled amplifier. Details of this amplifier are given. The repetition of experiments previously carried out by other methods indicate that the apparatus is reliable in use for counting H-particles. The number of H-particles obtained from aluminium and a strong RaC preparation is discussed. In the *Discussion*, **Stetter** considered that the method adopted is the correct one. The results of the scintillation method are in general much higher than those obtained with the apparatus described when observations are made of the H-particles from paraffin. The differences have as yet not found a satisfactory explanation. W. V. M.

1902. Wave Mechanics of α-Ray Tracks. N. F. Mott. *Roy. Soc.*, *Proc.* 126. *pp.* 79–84, *Dec.* 2, 1929.

In Gamow's presentation of the theory of radioactive disintegration the α-particle is represented by a spherical wave which slowly leaks out of the nucleus. On the other hand, the α-particle once emerged has particle-like properties, the most striking being the ray-tracks that it forms in a Wilson cloud chamber. It is difficult to picture how it is that an outgoing spherical wave can produce a straight track. This difficulty arises from the tendency to picture the wave as existing in ordinary three-dimensional space, whereas wave functions in the multispace formed by the coordinates both of the α-particle and of every atom in the Wilson chamber are really dealt with. Two atoms are considered and the positions of the nuclei of the atoms are treated as parameters. As the nuclei are many times heavier than the electrons and move very much more slowly than the α-particles, they may be considered effectively at rest during the whole time of formation of a track. It is then shown that the atoms cannot both be ionised unless they lie in a straight line with the radioactive nucleus. J. J. S.

1903. Nature of the Absorbable Radiation Accompanying the α-Rays of Polonium. Irène Curie and F. Joliot. *Comptes Rendus*, 189. *pp*. 1270–1272, *Dec*. 30, 1929.

The radiation in question was first observed by Russell and Chadwick in 1914, who, assuming that it was γ-radiation, found the value of μ/ρ in aluminium. The authors have measured μ/ρ not only in aluminium, but also in cellophane, which contains C, O, N and H; if the radiation were electromagnetic, μ/ρ would be greater in aluminium than in cellophane; the reverse is found to be the case, and this would be true for corpuscular radiation, α- or H-rays. Yamada has proved that polonium does not emit α-rays of long range, so that the radiation in question must consist of H-rays. The range of these rays in air was found to be about 16 cm.; they are probably due to the disintegration of nitrogen. Polonium sources on Ni and Ag also emit a smaller quantity (¼ or ⅕) of H-radiation with a range of about 14·5 cm., which may be due to occluded gas. Sources on Ag emit a little electromagnetic radiation, μ/ρ in aluminium 730, calculated wavelength about 3·9 Å., this corresponds to the L-rays of silver. No primary γ-radiation has been observed which can be attributed to polonium.
H. N. A.

1904. Influence of Temperature of Receiver on the Results of β-Ray Recoil from Thorium B. K. Donat and K. Philipp. *Zeits. f. Physik*, 59. 1–2. *pp*. 6–12, 1929.

Investigations on the yield of β-ray recoil from ThB show that, as in the case of ordinary condensation processes, the temperature of the recoil receiver influences the amount of the output. With a receiver of brass which was cooled from a room-temperature of 20° C. to − 180° C. the yield increased from between 2 % and 6·5 % to 22·7 %. Further cooling to − 245° C. gave no greater rise in the yield. (See also Abstract 959 (1928).] J. J. S.

1905. Absorption of Penetrating Radiation. H. Kulenkampff. *Phys. Zeits*. 30. *pp*. 561–567, *Sept*. 15, 1929.

The decrease of intensity of ultra-γ-rays on traversing matter is influenced by the long-wave radiation produced by dissipation. The author uses a method derived from radioactive disintegration to describe the conditions thus produced, and shows that a decrease of intensity of a primary monochromatic radiation differs materially from an exponential one, and that there are other qualities which are influenced by the admixture of long-wave radiation. E. E. F. d'A.

1906. Status of the γ-Ray Change. N. Feather. *Phys. Rev*. 34. *pp*. 1558–1565, *Dec*. 15, 1929.

It has been general to assume that the emission of γ-rays in radioactive disintegration is an effect subsidiary to the ejection of the α- or β-particle from the nucleus. Recently, however, the general experimental proof that the time interval concerned in this nuclear process is considerably greater than the time of relaxation of the inner extra-nuclear electrons—and, more particularly, an experiment by Jacobsen and its interpretation in terms of γ-ray disintegration constants as small as 10^5 sec^{-1}—have together resulted in a revision of opinion. In the present paper Jacobsen's interpretation is examined in more detail and is shown to imply that the emission of a quantum of γ-radiation between the β-particle disintegration of radium C and the α-particle disintegration of radium C′ is an absolute necessity. This condition is attended with certain difficulties. In the course of the investigation it is shown that where α-particles may be emitted either immediately following an earlier disintegration, or with the intermediate emission of any single member of a number of γ-ray quanta, then, as long as all the α-particles possess identical velocities, the α-activity of the immediate product of the former disintegration decays strictly according to the exponential law characterised by the disintegration constant of the α-particle change. In a second part of the paper an attempt is made to connect the complexity of the "normal" α-radiation of thorium C and the emission of long range α-particles from radium C and thorium C with the occurrence of certain lines in the γ-ray spectra of the elements in question. AUTHOR.

1907. Cosmic Ultra-Radiation. V. F. Hess and O. Mathias. *Phys. Zeits.* 30. *pp.* 766–767, *Nov.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

While the results of observation on the Sonnblick at a height of 3100 m. are not yet fully worked out, so that numerical results are not given, the authors point out that two radiation apparatus placed near each other and sheltered from radiation from the earth do not show parallel behaviour, but exhibit notable deviations. J. J. S.

1908. Spectral Distribution and Mean Wave-Length of Radium γ-Rays. D. Skobelzyn. *Zeits. f. Physik*, 58. 9–10. *pp.* 595–612, 1929.

Referring to his former paper in which he described the observations made on the ray-tracks produced in the Wilson chamber by Ra γ-rays filtered through lead, the author points out that the scattering coefficients calculated on the basis of the ascertained statistical distribution according to the theory of Klein and Nishina agree with those found experimentally within the possible errors of measurement, whilst on the contrary those calculated according to the Dirac-Gordon and Compton theories differ from the observed by about 34 % and 39 % respectively. On the basis of the Klein-Nishina theory the special distribution, the effective wave-length and the mean energy of a quantum of the RaB + C and the RaC γ-radiation are deduced, and the comparison with the photoelectrically ascertained spectrum is carried out. The distribution observed with stronger filtering was compared with the calculated and found in full agreement. J. J. S.

1909. Ionisation by H-Particles. Marietta Blau and Elisabeth Rona. *Akad. Wiss. Wien, Ber.* 138. 2a. 9–10. *pp.* 717–731, 1929.

Previous experiments on the ionisation by H-particles, which were liberated from paraffin by α-particles from polonium, were repeated with a stronger polonium preparation and a better arrangement. The ionisation by H-particles in dependence upon the velocity was found to proceed in a way parallel to that of α-particles. The number of the pairs of ions produced by an H-particle per cm. of its length of path was only a quarter of the number yielded by an α-particle of the same velocity. Using a radon capillary as primary source of rays the H-particles were magnetically deflected, and in a definite spectral region the ionisation in dependence on the velocity, the number of the particles remaining constant, was determined by change of the absorption. This arrangement also gave a course of the ionisation curve similar to that with α-particles. J. J. S

HEAT.

1910. Measurement of the Flow of Heat. A. F. Dufton and W. G. Marley. *Phil. Mag.* 8. *pp.* 841–844, *Dec.*, 1929. *Supplement.*

Description of instruments in detail for the measurement of radiation and convection by which these factors can be recorded as separate items, at or near the surface of walls. The instruments obviate the insertion of thermocouples in the surface of the wall. The convection of heat to a wall was recorded as the difference between the total flow of heat and the radiant heat. The present measurements show the convection of heat to a wall to be proportional to the 4/3 power of the temperature difference and equal to 0·315 B.Th.U. per square foot per hour for a temperature difference of 1° F. S. G. B.

1911. Thermal Conductivity of a Single Crystal of Bismuth in a Transverse Magnetic Field. G. W. C. Kaye and W. F. Higgins. *Phil. Mag.* 8. *pp.* 1056–1059, *Dec.*, 1929.

The change in thermal conductivity of a single crystal of bismuth was measured with the heat flow perpendicular to the magnetic field, and for the three orientations of the crystal, *viz.*, heat flow and magnetic field both perpendicular to the trigonal axis, heat flow perpendicular to the trigonal axis, magnetic field parallel to the trigonal axis, and heat flow parallel to the trigonal axis, magnetic field perpendicular to the trigonal axis. The results showed that for the first case the percentage decrease in thermal conductivity in a field of 11,000 gauss was 4·9 %, in the second case 7·3 % and 16 % for the third case. The work is being continued. [See Abstract 1903 (1929).] F. J. B.

1912. Kinetic Theory of Heat Conductivity in Crystals. R. Peierls. *Ann. d. Physik*, 3. 8. *pp.* 1055–1101, *Dec.* 23, 1929.

The mechanism of heat conductivity in crystals is investigated, and it is shown that the condition for the existence of a finite heat conductivity is identical with the condition for the existence of the H-theorem. This condition is fulfilled for a three-dimensional grating, and the particular characteristic of the dispersion law which is responsible is identified. The mechanism is shown to be more complicated than the case would appear according to the first law of Debye. The Debye result regarding the dependence of the phenomenon upon the temperature at high temperatures is verified. Neglecting the atomic structure, infinitely great heat conductivity results, and consideration of a linear chain of atoms gives a result proportional to $1/T^2$. For low temperatures there was an exponential fall of the heat resistance which, in consequence of grating deformation, is shown to involve a member proportional to T. S. G. B.

1913. Thermo-Regulator Improvements. S. C. Collins. *J. Phys. Chem.* 33. *p.* 1850, *Nov.*, 1929.

Two spherical bulbs are connected by a narrow tube containing mercury, the system being balanced just above its centre of mass. Above the surface of the mercury in the one bulb is air and in the other ether. For an increase in temperature the vapour pressure of the ether will be greater than the pressure of the air, and so mercury is forced through the connecting tube on to the other side and disturbs the balance of the apparatus and breaks the heating circuit. The level of the mercury is arranged so as always to be above that of the tube. It is, therefore, impossible for the air and ether vapour to be mixed if the apparatus is overturned.

W. C. S. P.

1914. Resistance Thermometry at the Temperatures of Liquid Helium. W. H. Keesom and J. N. van den Ende. *Akad. Amsterdam, Proc.* 32. 9. *pp.* 1171–1175, 1929. *Comm. No.* 203*c from the Phys. Lab., Leiden.*

Investigation on a number of alloys, to find one suitable to replace constantan and manganin as resistance thermometers. Phosphor-bronze has a resistance which varies linearly in liquid helium and has a relative change in this temperature region greater than previously obtained by any other alloy. It possesses the advantage of having a constant reproducible ice-point resistance after use in liquid helium, and its resistance is practically unaffected by magnetic fields. Providing it has not been annealed, the phosphor-bronze resistance thermometer appears to be the most satisfactory secondary thermometer for the liquid helium range of temperatures. In the case of technically pure Pt and the alloys Pt — Ag, and Pt — 10 % Ir, the change of resistance in liquid helium range of temperature is too small. Brass loses its resistance almost entirely in liquid helium; this is probably due to presence of tin. W. C. S. P.

1915. New Apparatus for Measuring the Coefficient of Expansion for Heat of Rods. J. Zahradníček. *Phys. Zeits.* 30. *pp.* 927–928, *Dec.* 15, 1929.

B. Macku has developed the following method: two circular brass plates are soldered to a constant temperature support, and they pass through the side of a central vertical tube which is electrically heated. The rod under test rests on the lower plate and passes through a hole made in the upper plate. Resting on this upper plate is an optical level with its third leg on the end of the rod. In order that the distance between the brass plates shall remain constant, the central heating tube is in two parts and connected by a rubber band. W. C. S. P.

1916. Experimental Demonstration of the Expansion of Solidifying Bismuth. H. Perlitz. *Phys. Zeits.* 30. *pp.* 928–929, *Dec.* 15, 1929.

A cylindrical rod of bismuth about 12 cm. × 11 mm. is slipped into a glass tube, evacuated and sealed. It is then heated in the tube above its melting point (271° C.) and is then placed in a beam of light from a projection lantern. The image of the meniscus is observed on the screen as a stream of cool air is played on to the tube. The apparent increase in volume on solidifying is 2·6 %, giving a real expansion of 3·3 %.

W. C. S. P.

1917. Thermal Expansion of Liquids. J. E. Verschaffelt. *Phil. Mag.* 8. *pp.* 858–860, *Dec.*, 1929. *Supplement.*

A criticism of the relation given by Thatte [see Abstract 3099 (1929)] derived from van der Waals' equation of state. J. J. S.

1918. Thermal Expansion of Jena Glass 16 III. W. H. Keesom and A. Bijl. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1164–1166, 1929. *Comm. No.* 203*a from the Phys. Lab., Leiden.*

From measurements of the linear expansion of Jena glass by van Agt and K. Onnes the coefficient of cubical expansion was given as 235·5

$\times 10^{-7}$. Miss Jansen's measurements by the weight thermometer gave $242{\cdot}4 \times 10^{-7}$. The authors have, therefore, repeated these measurements by both methods and have also extended them to lower temperatures, results being obtained at temperatures of liquid oxygen and hydrogen, ethylene, boiling water, and after this at the temperature again of liquid oxygen. As a result, the figures for temperatures 0° to 100° C. by the two methods are closer together than formerly, while values of the linear expansion in mm. per metre are given as:

15° to 100°	15° to − 102·8°	15° to − 182·6°	15° to − 252·7°
0·681	− 0·794	− 1·189	− 1·311

T. B.

1919. New Determination of the Normal Boiling Point of Oxygen. W. H. Keesom, (Miss) H. van der Horst and (Miss) A. F. J. Jansen. *K. Akad. Amsterdam, Proc.* 32. 9. *pp.* 1167–1170, 1929. *Comm. No.* 203*b from the Phys. Lab., Leiden.*

Previous determinations have given values as below: K. Onnes and Braak (1908), $-182{\cdot}98^{6}$° C.; Cath (1918), − 182·95° C.; Henning (1914), − 182·97° C.; Henning and Heuse (1924), − 183·00° C. As the normal boiling point of oxygen is of great importance in fixing an international temperature scale, the authors have undertaken a new determination, making use of the latest results for the thermal expansion of Jena glass 16 III [see preceding Abstract]. The value found is − 182·977° C., and the full results at pressure p mm. is given by the equation $t = -182{\cdot}977 + 0{\cdot}01231\,(p - 760) - 0{\cdot}00001624\,(p - 760)^2$]. T. B.

1920. Boiling Point of Water as a Function of the Pressure. A. Zmaczynski and A. Bonhoure. *Comptes Rendus*, 189. *pp.* 1069–1070, *Dec.* 9, 1929.

The apparatus devised by W. Swietoslawski for the measurement of the boiling point of water at different pressures was used. The temperature of ebullition was determined by means of two electric resistance thermometers which had been compared with the standard thermometers of the *Bureau international des Poids et Mesures.* Smith's differential bridge was used to measure the resistance of the thermometers. By means of the ebullioscopes used the boiling point can be determined with an accuracy of 0·001° to 0·002°. The result of the various measurements gives the following:

$$\Theta = 57{\cdot}2587 + 0{\cdot}0793722p - 35{\cdot}5273 . 10^{-6}p^2 + 6{\cdot}6950 . 10^{-9}p^3,$$

where Θ represents the temperature expressed on the normal scale of the hydrogen thermometer and p the pressure in mm. of mercury. J. J. S.

1921. Flow of Gases through an Orifice in a Thin Wall at Different Temperatures. M. Chopin. *Comptes Rendus*, 189. *pp.* 979–982, *Dec.* 2, 1929.

Shows that it is possible, using slightly superheated water vapour in a stream the water content M of which is measured, to modify the method previously described so as to be able to use a single orifice to measure the temperature of the issuing gas. The orifice employed was 6 mm. in diameter in the middle of a platinum disc 0·3 mm. in thickness. The temperature was taken with a thermocouple placed outside the opening, apparently in the *vena contracta* of the vapour jet. The author comes to the conclusion that the loss of heat by radiation can be neglected under the conditions of the experiment. Making M constant in all the measurements, it was found that the ratio T/p was practically constant when T, the absolute temperature, varied from 636° to 1298°, p being the pressure of the vapour. This shows that the " coefficient of contraction " of the orifice is practically constant. The measurements provide a new verification of the aerodynamic method of measuring the temperature of a gas, which could only be vitiated by variation of the coefficient of contraction of the orifice. **Errata,** *ibid.*, p. 1334, Dec. 30, 1929. H. N. A.

1922. Variation with Temperature of Thermal Separation in Gaseous Mixtures. J. W. H. Lugg. *Phil. Mag.* 8. *pp.* 1019–1024, *Dec.,* 1929.

The thermal separations for a single mixture of hydrogen and carbon dioxide were studied with the cold bulb temperature at 29° C. and the hot bulb at temperatures between 100° C. and 464° C. with the object of especially exploring the region between 230° C. and 490° C. to determine whether the observed variation of k_T in Chapman's integrated logarithmic formula $\Delta\lambda = k_T \log_e \frac{T_2}{T_1}$, where $\Delta\lambda$ is the composition difference and T_1 and T_2 are the absolute temperatures, could be confirmed, and if so to study the conditions under which it becomes invalid. The experimental methods adopted are briefly described, and the results, which are tabulated, seem to show that the separations at the higher temperatures are greater than would be expected from the formula, but the relationship between composition difference and temperature is more nearly linear. J. G. H. B.

1923. Specific Heat at High Temperatures. W. Nernst and K. Wohl. *Zeits. f. techn. Physik,* 10. 12. *pp.* 608–614, 1929. *Paper read before the Deut. Phys. u. Math., Prague,* 1929.

An important contribution to the knowledge of the subject. The theoretical aspects are reviewed in accordance with modern theory and the development of an explosion method for experiment follows. The results are finally recorded in two tables showing the mean molecular heats at constant volume for a range of temperatures up to 2800° from 273° Abs. These tables supersede those put forward by Nernst previously in his textbook of theoretical chemistry. H_2, HCl, N_2, CO, O_2, Cl_2, CO_2, H_2O, NH_3 and $(C_2H_5)_2O$ are included in the tables. S. G. B.

1924. True Specific Heat of Nickel. E. Lapp. *Ann. de Physique,* 12. *pp.* 442–521, *Dec.,* 1929.

The specific heat of pure nickel is determined at temperatures from − 175° to + 460° C. by a non-adiabatic electrical method, of which full details are given. The nickel wire, 2 mm. thick, and of purity 99·51 %, is placed in a uniformly heated electric furnace and its temperature raised about 2° C. at a time by a carefully measured electric current. The specific heat C is calculated in the usual way, allowance being made for loss of heat from the wire, the temperatures of the furnace and the wire being obtained by means of nichrome-nichrome couples. $C = W . t/J . m . \Delta\theta$, where W = watts given to the wire for time t, m the mass of the wire and $\Delta\theta$ the increase in temperature of the wire. The results are represented in tables and curves. The specific heat C increases from a value 0·055 at − 175° C.

up to the " Curie point," where a discontinuity from 353° to 360° C. occurs, C rapidly decreasing from 0·1577 to 0·1278. From this point up to 460° C. C increases slowly to a value 0·1288. A calculation is made of all the terms of the specific heat of which the influence is known, *i.e.*, the quantal term, the dilatation, the known magnetic term (in a ferro-magnetic body) and the " unknown " magnetic term. Curves and tables follow, with values of the atomic heat corrected successively for all the terms mentioned. T. B.

1925. Specific Heat under Conditions of Constant Internal Energy and of Constant Heat Content. H. Mache. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 8. *pp.* 629–634, 1929.

A brief thermodynamic discussion of the two specific heats under the above conditions, with their relations to the ordinary constant-pressure and constant-volume specific heats, and to the equation of state. J. H. A.

1926. Heat Capacities of Real Gases and Mixtures of Real Gases. J. A. Beattie. *Phys. Rev.* 34. *pp.* 1615–1620, *Dec.* 15, 1929.

Simple approximate equations expressing C_V and C_p of gases as functions of p and T are given. They are derived by neglecting all powers of $1/V$ higher than the first and replacing $1/V$ by p/RT in the complete equations for C_V and C_p which are obtained by using the Beattie-Bridgeman equation of state and which express these quantities as functions of V and T. The resulting relation for C_p reproduces the thermal data on air well, and those on ammonia fairly well. The complete and approximate equations for C_V and C_p of gas mixtures expressing these quantities as functions of V and T, and of p and T, are given. They are derived by use of the generalised Beattie–Bridgeman equation of state for gas mixtures on the basis of one assumption: that of the additivity of energy of real gases at infinitely low pressures. AUTHOR.

1927. Exact Determination of Vapour Pressures. A. Smits and E. Swart. *Chem. Soc., J. pp.* 2724–2726, *Dec.*, 1929.

For the removal of the last traces of dissolved air, the liquid is repeatedly frozen and liquefied *in vacuo* and finally distilled *in vacuo* into a collecting vessel through a U-tube which is arranged to serve at intervals as a differential manometer. The cycles of freezing and liquefaction are not alone sufficient, as is shown by the manometer during the second stage of the process. L. V. C.

1928. Vapour Pressures of Sulphur. W. A. West and A. W. C. Menzies. *J. Phys. Chem.* 33. *pp.* 1880–1892, *Dec.*, 1929.

Gives details of the experimental methods used in the measurement of vapour pressures of sulphur between 100° and 550° C. Constants have been calculated for an empirical equation which represents these observations, and from this has been constructed a table of vapour pressures for each 10 degrees over this range. The results of previous workers are compared with those given by this equation. The heats of vaporisation and entropies of vaporisation have been calculated over the same range and their abnormalities discussed in relation to the molecular constitution of liquid and vapour. C. O. B.

1929. Rate of Attainment of Vapour-Pressure Equilibrium in Liquids. W. A. West and A. W. C. Menzies. *J. Phys. Chem.* 33. *pp.* 1893–1896, *Dec.*, 1929.

Give the results of experimental work carried out with a view of testing a statement by H. B. Baker (*J. Chem. Soc.*, 1927, 951) that the vapour pressures measured at room-temperatures of certain undried liquids were appreciably raised by previous prolonged treatment at high temperatures, which he considered to be due to a delay in attainment of internal equilibrium. The results are given on benzene, water, acetone, ethyl alcohol, acetic acid and sulphur. The temperature of heating varied from 65° to 125° C. above the comparison temperature and the limit of observable pressure difference averaged less than 0·05 mm. of mercury. In no case was a delay in vapour-pressure equilibrium found which was distinguishable from the lag in thermal equilibrium. C. O. B.

1930. Vapour Pressure of Solutions of Potassium in Liquid Ammonia. W. C. Johnson and A. W. Meyer. *J. Phys. Chem.* 33. *pp.* 1922–1930, *Dec.*, 1929.

The vapour pressures of solutions of potassium in liquid ammonia have been measured at 0°, − 33·5° and − 50·38° over a considerable concentration range. The vapour pressures of the saturated solutions at these temperatures are 750 mm., 162 mm. and 63 mm. respectively. The solubility increases slighly with increasing temperature from − 50·38° to 0°. The composition of the saturated solution, expressed in gramme-molecules of ammonia per gramme-atom of potassium, is 4·68 at 0°, 4·95 at −33·5° and 5·05 at −50·38°. There is no evidence for the formation of a compound between potassium and ammonia. AUTHORS.

1931. Influence of an Indifferent Gas under High Pressure Upon the Vapour Pressure of Water. J. J. van Laar. *Zeits. f. phys. Chem.* 145. 3–4. *pp.* 207–219, *Dec.*, 1929.

The author shows that the fourfold raising of the vapour pressure of water experimentally found by Bartlett, when an indifferent gas (*e.g.*, N_2) is introduced at high pressure (*e.g.*, 1000 atmospheres) to form a mixture with water vapour, can be exactly and entirely accounted for and made to fit in with the thermodynamical theory. The experimental results of Bartlett are found to be in good agreement with the theoretical values deduced for H_2O and N_2 at 50° C. and 1000 atmospheres. It is found that the value for p_1/p_2 from theoretical data is 3·846, whilst experimentally determined it is 3·933. S. G. B.

1932. Fundamental Equations in Kinetic Theory of Liquids and Gases. D. Enskog. *Arkiv f. Mat., Astron. och. Fysik, Stockholm,* 21*a*. 13. [28 pp.], 1929. *In German.*

This is a mathematical paper containing 71 equations, in which the author attempts to extend the kinetic theory of rarefied gases to compressed gases and liquids. In order to avoid the greatest mathematical complications, the author employs van der Waals' assumption on the mutual action between molecules. The paper is not suited to a short abstract. T. B.

1933. New Measurements on the Vapour-Pressure Curve of Liquid Helium. Part I. W. H. Keesom, S. Weber and G. Norgaard. *K. Akad. Amsterdam, Proc.* 32. 7. *pp.* 864–873, 1929. *Comm. No.* 202*b from the Phys. Lab., Leiden.*

In these measurements [see Abstracts 2140 (1928) and 1316 (1929)] the pressure in the helium thermometer becomes very low at the lowest temperatures, at which also measurements must be made with a thermometer with low ice-point pressure. Under these conditions the thermomolecular pressure difference between thermometer bulb and manometer appeared to be important. The results now given are corrected for this difference in thermomolecular pressure between the bulb and the hot-wire manometer of the helium thermometers. At the different absolute temperatures employed, the vapour pressures of helium in cm. of mercury are: 4·22°, 76; 3·79°, 50; 3·21°, 25; 2·63°, 10; 2·29, 5; 2·01°, 2·5; 1·72°, 1. The transformation point HeI — HeII is 2·18° Abs. T. H. P.

1934. Relation between Distillation Phenomena of Binary Systems and the Vapour-Pressure—Temperature Curves of their Components. M. Lecat. *Comptes Rendus*, 189. *pp.* 990–992, *Dec.* 2, 1929. *Ann. Soc. Sci. de Bruxelles*, 49. *Ser. B. pp.* 261–333, *Dec.*, 1929. *Accad. Lincei, Atti*, 10. *pp.* 649–653, *Dec.* 15, 1929.

Considers how the existence of azeotropism in binary mixtures can be predicted from a study of the vapour-pressure-temperature curves, and other lines of the temperature-pressure diagram. There may be azeotropism when the curves intersect, but also in other cases. A table has been constructed for 972 systems formed of 194 bodies of very various kinds, and is published elsewhere. There are 489 cases of intersection of the γ-curves, 377 cases of azeotropism and 112 of zeotropism; figures are also given for cases where there is no intersection. Considers the effect of the chemical relation between the two members of a mixture. H. N. A.

1935. Thermodynamic Treatment of Stationary Conditions in Non-Isothermal Systems. C. Wagner. *Ann. d. Physik.* 3. 5. *pp.* 629–687, *Nov.* 28, 1929.

The problem under discussion can be stated in general terms. Consider a phase in which at one point a known temperature exists (T_1), and at another point, separated from the first by a thin membrane, a different temperature (T_2) is found. This temperature difference is maintained constant by addition or subtraction of heat from two heat reservoirs corresponding to the two sides of the membrane. The specific characteristics of the systems at both points are investigated, in particular the pressure and molecular conditions of the independent variables concerned, as also eventually the electric potential characteristic of such a system. The problem is somewhat akin to the Ludwig–Soret phenomenon in two communicating portions of a solution at different temperatures. Finally, the treatment can be applied to thermoelectric phenomena, and including the discussion of the difference of potential at two places at different temperatures in a homogeneous conductor. The paper is mathematical throughout, and includes discussions of the definition of the equations of state for the stationary state in non-isothermal phases; the stationary pressure differences in such systems; and the general case and specific instance when $dp = 0$; also the Knudsen effect. Electromotive effects of thermocouples made from metallic conductors, with solid electrolytic conducting salts, and with dilute electrolytic solutions, as well as the various aspects of the Ludwig–Soret phenomenon are also discussed. S. G. B.

1936. Empirical Calculation of the Fugacities in Gaseous Mixtures. Part II. Its Relation to the Tangents on Certain Thermodynamic Diagrams. Approximate Equations for Some Important Thermodynamic Properties of Gas Mixtures. L. J. Gillespie. *Phys. Rev.* 34. *pp.* 1605–1614, *Dec.* 15, 1929.

In Part I [see Abstract 256 (1930)] it was shown that, if $v_1' - v_1$ is the excess of the partial molal volume of a gas in a mixture of gases over its volume when pure at the temperature and pressure of the mixture, then the limiting value of $v_1' - v_1$ at zero pressure is finite and positive, and can be calculated by a linear combination of constants previously tested at high pressures. Equations are given to calculate the limiting value of the tangents in certain thermodynamic diagrams. From the limiting values of the tangents there have been derived, by approximate integration, equations explicit in the pressure for the change of energy, entropy, heat content, *t-p* and *t-v* thermodynamic potentials on mixing gases at constant temperature and pressure. It is believed that these approximate equations should furnish, in connection with adequate equations of state, satisfactory thermodynamic calculations for pressures not too high. It is shown that the variation of the mass-action function K_p with composition at constant temperature and pressure depends at low temperatures chiefly on the cohesive pressure constants A of the gases involved. T. B.

1937. Engines which Function between Two Radiant Sources. T. Takeuchi. *Comptes Rendus*, 189. *pp*. 1067–1068, *Dec*. 9, 1929.

A discussion of the functioning of a reversible engine which produces work as the result of the effects of two radiant sources. The material of the machine is such that it constitutes an oscillatory body. The paper discusses the frequency of the machine under a variety of circumstances. The findings agree with those of J. Q. Stewart [see Abstract 1528 (1930)].

S. G. B.

1938. Degeneration of Gases. F. I. G. Rawlins. *Zeits. f. Physik*, 58. 11–12. *pp*. 830–832, 1929.

A mathematical note, based on the general equation $pv = R\phi(T, V)$ given by Bennewitz [see Abstract 2805 (1924)]. At low temperatures on either the Bose-Einstein or the Fermi Statistics, there is more or less degeneration. The function ϕ is given by $\phi = T\psi(C/TV^{2/3})$; denoting $C/TV^{2/3}$ by $\psi'/\psi \log a$, we have for $T \rightarrow \infty$ $\psi' \rightarrow 1$, $a \rightarrow 0$. The Joule-Kelvin effect for a degenerated gas is discussed, and $T\psi$ shown to be constant, whence the effect depends on temperature. The Mollier diagram for a degenerated gas is considered, and the general equation for the inclination of the curves in the diagram is shown to be $(\partial H/\partial T)_p = T(1 + 2/3a)$; for high temperatures this becomes the classical expression $\lim_{T=\infty} (\partial H/\partial T)_p = T$.

T. B.

1939. Laws of Velocity of Gas Molecules. G. Jäger. *Akad. Wiss. Wien, Ber*. 138. 2*a*. 8. *pp*. 601–605, 1929.

Maxwell stated that the probability was that the velocity component of a gaseous molecule was independent of other components. Boltzmann and others have confirmed this statement, and the present work is directed to proving the statement from a new point of view, and is a corollary to the author's work as set out in the *Handbuch der Physik*, Band IX, p. 375, 1926. The paper deduces an expression for the distribution law, which is in consonance with previous workers, showing that the velocity components are not dependent on each other, since the hydrostatic fundamental equations are also independent. S. G. B.

SOUND.

1940. Density of Sonorous Energy in Reverberation. G. Polvani. *N. Cimento*, 6. *pp.* 330–343, *Aug.–Sept.–Oct.*, 1929.

A theoretical study of some quantitative properties which occur in the end conditions of the phenomenon, and illustrate the behaviour of diffused sonorous energy in reverberation effects when the surges of sound vary periodically and intermittently. New experimental methods are suggested for the solution of acoustic problems occurring in architecture, and especially for finding standard reverberation time. J. J. S.

1941. Photographic and Acoustic Studies on the Firing of a Gun. Z. Ishi and T. Katayama. *Imp. Acad. Tokyo, Proc.* 5. *pp.* 338–340, *Oct.*, 1929. *In English.*

Briefly describes the results of photographic and acoustical studies of the secondary explosion for a 10 cm. calibre gun, due to the ignition of the gaseous combustion products as they rush out of the muzzle. Generally a large intense flame with a funnel-shaped part near the muzzle is obtained. Another example illustrated is a low-intensity flame which occurs quite a distance from the muzzle, but this is only a peculiar type of secondary explosion. There is a third kind, in which the secondary explosion does not take place, but the escaping gas emits radiation solely due to its high temperature. The flame in this case has an extremely low intensity and a definite surface of maximum luminosity, which appears to be part of a sphere whose centre is at the muzzle. From measurements by means of a potassium photoelectric cell, it is found that the duration of combustion is generally between 0·1 and 0·3 sec., whilst the flame starts 0·005 to 0·01 sec. after the cannon ball has passed. An audiometer record of the report of the gun shows two marked disturbances, the first vibration in the curve being due to the initial explosion, whilst the second is due to the secondary explosion. R. C. F.

1942. Pierce Acoustic Interferometer for Determining Velocity and Absorption. W. H. Pielemeier. *Phys. Rev.* 34. *pp.* 1184–1203, *Oct.* 15, 1929.

The coefficient of absorption A of sound waves, at a distance x from a source, is contained in the expression: $I = I_0 e^{-(A/\lambda^2)x}$. It was determined theoretically by Lebedew [see Abstract 1186 (1911)] and experimentally by Neklapajeff [see Abstract 1185 (1911)]. The paper describes its investigation by means of a quartz oscillator apparatus. The crystal forms part of a thermionic valve circuit, and the interfering sound waves react on it in such a way as to cause periodic changes in the plate current when the reflecting mirror is displaced a half wave-length or more. Several observed facts indicate a variation of wave-velocity with intensity, and measurements in air and CO_2 at frequencies from $3(10)^5$ to $14(10)^5$ give a slightly higher velocity than the commonly accepted value for audible frequencies. The absorption by air and CO_2 increases with frequency through this range, CO_2 being nearly opaque at $14(10)^5$. Lebedew's constant has a value of 0·00037 for air at 20° C. The observed values of A for CO_2 were 0·012 at $3(10)^5$, 0·0096 (by torsion vane) at $6·5(10)^5$, and 0·0073 at $12(10)^5$. The humidity has a marked effect on the absorption in CO_2. G. E. A.

1943. Reflection of Sound Energy and Thickness of Plate Reflector—Ultrasonic Method. R. W. Boyle and D. K. Froman. *Canad. J. of Research*, 1. *pp*. 405–424, *Nov*., 1929.

The work is an amplification of the method introduced previously by Boyle and Lehmann [see Abstract 2957 (1927)], and illustrates the application of the theory of monochromatic interference spectroscopy of optics to sound. By experiments with lead, duralumin and paraffin, at different high frequencies, the effects of both high and low reflecting powers are shown, and also the possible influences of harmonics. It is also shown that in travelling through thin discs the velocity of the waves is given more accurately by the bulk modulus of elasticity than by Young's. AUTHORS.

1944. Wave-Form of a Sound Produced by a Spark. J. Okubo and E. Matuyama. *Phys. Rev*. 34. *pp*. 1474–1482, *Dec*. 1, 1929.

By using Michelson's interferometer, the wave-form of a sound produced by a condensed spark has been studied. It has been found that the wave consists of a high-frequency oscillation of air of the order 10^{-4} sec., having two discontinuities, one being due to a condensation at the head and the other to a rarefaction at the tail. The variation of the wave-form has also been observed as it propagates onwards. AUTHORS.

1945. Transverse Velocity Gradient Near the Mouths of Pipes in which an Alternating or Continuous Flow of Air is Established. E. G. Richardson and E. Tyler. *Phys. Soc., Proc*. 42. *pp*. 1–15, *Dec*. 16, 1929.

A comparison is made of the alternating and direct flow of air near the mouths of tubes of various sections, by traversing a hot-wire anemometer across the tube. After a correction for the use of the hot wire in the neighbourhood of the walls of the tubes has been made, the theoretical and observed gradients of mean velocity across the sections are compared. In the alternating flow a peak of high average velocity is found near the walls of the pipe, but in one-way flow this annular peak is absent, the velocity falling continuously from the centre of the tube to within a short distance of the walls according to the law $v = ay^q$, where q varies from 1/2 for stream-line flow up to 1/7 for turbulent flow. The existence of a layer of laminar flow close to the walls, when the main body of air is in turbulent motion, is demonstrated. AUTHORS.

1946. Dissipation of the Energy Transported by a Sound Wave in Air. T. Vautier. *Comptes Rendus*, 189. *pp*. 1253–1255, *Dec*. 30, 1929.

In previous papers the author has described experiments on explosions in tubes and given wave-forms obtained by the interferential method. The surface between the line of equilibrium and the time-pressure curve is proportional to the energy of the wave, and the variation of this surface as the wave travels along the tube makes it possible to follow the dissipation of the energy. A study of the previous results on these lines shows that if the wave is reflected at the end of the tube, ψ, the coefficient of reflection, is equal to 0·92 for short waves and 0·96 for long ones, and σ, a constant in the equation $S = S_0e^{-\sigma x}$, which shows how the energy diminishes with x, the distance travelled in cm., is equal to $2{\cdot}2 \times 10^{-7}$ for short waves and $1{\cdot}6 \times 10^{-7}$ for long ones. H. N. A.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

1947. Electrostatic Problems. G. Silva. *Elettrotecnica*, 16. *pp.* 807–809, *Dec.* 15, 1929.

The author gives some explanations and fuller treatment of problems in electrostatics which were dealt with in his former paper, and considers some fundamental principles. In conclusion, examples are given of practical applications. J. J. S.

1948. Solution of Two Potential Problems in Electrostatics. E. Hallén. *Arkiv f. Mat., Astron. och Fysik, Stockholm*, 21*a*. 22. [44 *pp*.], 1929.

A mathematical discussion of the problem of the distribution of an electric charge on a conductor consisting of the convex surface of a circular cylinder cut at right angles. The conductor may not be under the influence of other electric charges, or in a known field rotationally symmetrical round the axis of the cylinder. In the first part of the paper the general case is dealt with when the length of the cylinder and the radius are of the same order of magnitude. The formula obtained does not cover all possible cases, but is in its actual form invalid if the diameter of the cylinder is smaller than the length of the cylinder. The author considers that the method of solution may be of interest, as it is based on the use of integral equations which may be found applicable to other problems. In the second part, by another investigation, the distribution of electricity on a long cylinder is deduced. J. J. S.

1949. Electric Effect of Water Jets in Vacuum. A. Bühl. *Ann. d. Physik*, 3. 7. *pp.* 978–992, *Dec.* 18, 1929.

An experimental investigation was made of the electrical effects obtained with jets of water impinging on an insulated metal disc in an evacuated chamber. The first simple apparatus used only established the existence of negative carriers, but further experiments with an improved type of apparatus, using a very fine jet, showed the existence of both positive and negative carriers, the latter being apparently more numerous than the former. With higher vapour pressures the ratio of negative to positive carriers is greater than at lower pressures. The results generally show that the breaking up into drops of a water jet in vacuum produces electrification which is connected with the withdrawal of electrical carriers from the water surface. The results are briefly discussed. A. W.

1950. Possibility of Determining the Piezoelectric Constant at High Temperature by the Statical Method. R. D. Schulwas-Sorokina. *Phys. Rev.* 34. *pp.* 1448–1450, *Dec.* 1, 1929.

It is suggested that the measurements of the variation with temperature of the piezoelectric effect in quartz and Rochelle salt are probably not reliable because of failure to take into account the effect of the electrical conductivity of the crystals. AUTHOR.

1951. Potential Difference at Boundary Layers between Metal and Air. Marie Andauer. *Zeits. f. phys. Chem.* 145. 3–4. *pp.* 220–226, 1929.

The value of the potential at the boundary between metal and air under similar conditions varies between values 0·02 and 0·03 volt. The present work was undertaken to see if this potential altered along the length of a metal wire, which was at one point brought into contact with a caustic soda solution and alternately polarised as anode and kathode. Using Pt, Ag, Ni and Fe, an alteration of the boundary potential between the metal and air was found and measured, and the phenomenon duly explained. Pd, Cu and Al did not exhibit the phenomenon at all. Experimental details and tables of results are appended. S. G. B.

1952. Dependence of Certain Electrical and Electro-Optical Constants of Nitrobenzene and Nitrotoluenes on their Degree of Purity. F. Hehlgans. *Phys. Zeits.* 30. *pp.* 942–946; *Disc.*, 946, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929. *Zeits. f. techn. Physik*, 10. 12. *pp.* 634–637, *Dec.*, 1929.

Experiments are described in detail for the correlation of the specific resistance, electrical tenacity, electro-optical Kerr constant, photo-voltage characteristic and dielectric constant of nitrobenzene, and of ortho- and meta-nitrotoluenes with their degree of purity. Tables of results showing the remarkable effects due to impurities are included. H. H. Ho.

1953. Variation of Dielectric Constant with Frequency. J. H. L. Johnstone and J. W. Williams. *Phys. Rev.* 34. *pp.* 1483–1490, *Dec.* 1, 1929.

Measurements of dielectric constants were made of solutions of nitrobenzene and para-dichlorobenzene in mineral oil of high viscosity at three concentrations. A decrease in the dielectric constant of nitrobenzene is found with increasing frequency. Para-dichlorobenzene shows no dispersion effect. An approximate value of the relaxation time for nitrobenzene is calculated from the Debye formula after corrections are made for molecular associations. The diameter of the nitrobenzene molecule calculated from it is of the right order of magnitude. AUTHORS.

1954. Dielectric Constants of Helium and Argon. G. W. Brindley. *Leeds Philosoph. and Lit. Soc., Proc.* 2. pp. 1–7, *Dec.*, 1929.

The author discusses the expressions obtained by J. H. Jones and by J. H. van Vleck for the dielectric constant of atomic hydrogen on the basis of the classical theory, and by Epstein, Pauling and Podolsky by other methods. Hartree has derived a charge distribution which can be represented approximately by hydrogen-like distribution, such that for each electron an effective nuclear charge can be obtained which reproduces approximately the Hartree charge distribution. In applying theoretical expressions for the dielectric constant derived for hydrogen-like atoms to the Hartree distribution there is a range of values of the effective nuclear charge for all of which the fit, when applied graphically, is equally good. The uncertainty in the effective nuclear charge is least for the inner electrons of atoms of large atomic number, and largest for the outer electrons, and, for a particular group, for atoms of smallest atomic number. The results are applied to the cases of He and A. The agreement is good for He, but for the M electrons of A considerable uncertainty exists. It is concluded that the method can only be applicable to small atoms and ions in which the outer electron distributions do not depart greatly from the hydrogen-like type, a condition well satisfied by He. R. S. R.

1955. Alteration of the Dielectric Constant of a Highly Rarefied Gas by Electrons. S. Benner. *Ann. d. Physik*, 3. 7. *pp*. 993–996, *Dec*. 18, 1929.

Bergmann and Düring have made use of formulæ due to Salpeter in connection with their recent experiments on the above subject. The author shows that these formulæ are inapplicable under the conditions of these experiments, and deduces new formulæ giving the conductivity of the dielectric due to the electrons passing through it, and the change produced in the dielectric constant. Sufficient data are not available to make it possible to test the new formulæ. H. N. A.

1956. Globular Lightning. Excavating Globes. E. Mathias. *Comptes Rendus*, 189. *pp*. 1049–1052, *Dec*. 9, 1929.

Globular lightning may either bore cylindrical holes in, or dig out furrows along, the surface of the earth according to the slope of the surface. The fulminating matter is thought to be in the spheroidal state, and rotating rapidly, its energy being converted directly into the mechanical work of excavation, its volume diminishing *pari passu*. The change of colour from blue to white and red in one case is attributed to the presence of sulphur on the surface at first, this disappearing as the superficial layer disappears, leaving only pure fulminating matter, which exhibits the colours of a black body gradually cooling. C. A. S.

1957. Effect of Condensation-Nuclei in Atmospheric-Electric Observations. G. Builder. *Terr. Mag*. 34. *pp*. 281–286, *Dec*., 1929.

Curves are given, based on observations made at the Watheroo Magnetic Observatory, showing the relations found between the counts of condensation-nuclei made with an Aitken counter and the simultaneous values of the atmospheric conductivity and potential-gradient. There is some disagreement with the data given by Wait, based on fewer observations. It is concluded that, for the range of observation, there is an approximately linear relation between the nuclei-count and the reciprocals of the polar conductivities and between the nuclei-count and the atmospheric potential-gradient. Owing particularly to the influence of the distribution of the pollution with respect to height the potential-gradient curves are not very definite. The effect of the pollution on the conductivity is expressed in terms of the linear recombination-law of Schweidler and the extension of this to explain the effect of high values of humidity is noted. An approximate and non-linear extrapolation of the curve for reciprocals of negative conductivity against nuclei-count is given based on Schweidler's equation of recombination in the presence of Langevin ions and uncharged nuclei. AUTHOR.

1958. Formation of Electrical Charges in Clouds. C. Dauzère. *Comptes Rendus*, 189. *pp*. 1092–1094, *Dec*. 9, 1929.

The author considers that part of the negative charge in the upper part of cumulo-nimbus clouds arises from the attraction exerted by the positively charged ice crystals in the cirrus clouds, the positive charge being caused by ultra-violet light. The drops inside the cloud will be positively charged and retain this charge in subsequent vertical motions. The same process, though in a less degree, occurs in other rain clouds, and this process would account for the positive charge on rain and on hail or snow. This process is considered supplementary to Simpson's theory of the electrical charges on rain. R. S. R.

1959. Theory of Permanent Magnetic Fields of the Sun and Earth: A Correction. R. Gunn. *Phys. Rev.* **34.** *pp.* 1621–1622, *Dec.* 15, 1929.

Calculations by Page [see Abstract 1152 (1930)] applied to the problem of the origin of the magnetic fields of the sun and earth show that earth currents arising from internal electric or gravitational fields crossed with a self-generated magnetic field tend to magnetise the earth rather than demagnetise it as was originally assumed. By attributing the observed field to electric and magnetic effects alone, ion free paths of only 10^{-7} cm. are required, whereas the original current systems which were attributed to an inhomogeneous magnetic field indicated that free path lengths of 3×10^{-6} cm. were necessary. The qualitative features of the original theory are unchanged. [See Abstract 3662 (1929).] AUTHOR.

1960. Preliminary Results of Ocean Magnetic Observations on the Carnegie. J. P. Ault. *Terr. Mag.* **34.** *pp.* 287–291, *Dec.*, 1929.

The paper continues the record of magnetic observations [see Abstract 3659 (1929)], those tabulated having been taken during a cruise from Japan to California and Hawaii from June to September, 1929. On the trip from San Francisco a peak was relocated which rises out of a general depth of 14,000 ft. to a height of about 10,000 ft. G. E. A.

1961. Preliminary Values of the Annual Changes of the Magnetic Elements in the Caribbean Sea and Pacific Ocean, from the Carnegie Results, 1909–1929, and the Galilee Results, 1905–1908. J. P. Ault and H. W. Fisk. *Terr. Mag.* **34.** *pp.* 292–299, *Dec.*, 1929.

The tables of values, although not final, are of sufficient accuracy to meet all practical needs. They follow on the records of a previous paper [see Abstract 2839 (1929)]. G. E. A.

CURRENT ELECTRICITY, MAGNETISM AND ELECTRO-MAGNETISM.

1962. Conductivity of New and Old Surfaces of Rock-Salt in Moist Air. Marie Hoschtalek. *Akad. Wiss. Wien., Ber.* 138. 2*a*. 9–10. *pp.* 767–780, 1929.

The conductivity of surfaces of rock-salt, along their cleavage planes, in moist air, and its dependence upon vapour pressure, temperature, and age, was carefully investigated. At room-temperature the conductivity was first measurable at a vapour pressure above 4·4 mm. The vapour-pressure/conductivity curve was found to be convex to the vapour-pressure axis. In addition to cleavage, the conductivity was affected by treatment with spark discharge or kathode rays. The conductivity diminished with time, and it was shown that an approximately linear relationship existed between the rate of change and the reciprocal of the absolute temperature. F. J. B.

1963. Test of Ohm's Law for Solid Electrolytes which are Good Conductors. W. Jost. *Zeits. f. phys. Chem.* 6. *Abt. B.* 3. *pp.* 210–214, *Dec.*, 1929.

The current and potential were measured for silver iodide and silver chloride, with potential gradients varying from 0·03 to 9·0 volts per cm., and it is concluded that Ohm's law is obeyed. The results are discussed, and are considered to disprove Smekal's theory of ionic conduction. J. H. A.

1964. Violation of Ohm's Law by Alternating Currents in Circuits Containing Capacity and Resistance. O. Franke and O. Riediger. *Zeits. f. Elektrochem.* 35. *pp.* 914–919, *Dec.*, 1929.

Ahmadi and Tandon's conclusions [see Abstract 745 (1930)] are shown to be erroneous. T. H. P.

1965. Resistance and Capacity Measurements by Condenser Discharges, with Application to the Measurement of Dielectric Constants and Conductivity of very Dilute Solutions. J. Malsch. *Ann. d. Physik*, 3. 6. *pp.* 803–822, *Dec.* 4, 1929.

The theory of the single-spark method of Wien [see Abstract 789 (1923)], also of Meisser [Abstracts 979 and 980 (1924)], is developed further, the integral effect for a differential equation of the fourth order being given, and the method considered particularly as a means of measuring resistance and capacity. An experimental arrangement is described by which the alteration, in intense fields, of the conductivity of solutions with the strength of field (Wien effect) and that of the dielectric constant (Debye effect) may be observed simultaneously. T. H. P.

1966. Hall Effect in Permalloy. A. W. Smith and R. W. Sears. *Phys. Rev.* 34. *pp.* 1466–1473, *Dec.* 1, 1929.

The Hall effect has been studied in three permalloys, the composition being 84, 81 and 78 % nickel with the remaining part iron. The observed transverse electromotive forces are unsymmetrical for the two opposite directions of the magnetic field. This dissymmetry arises from an unsymmetrical change of resistance in the transverse magnetic field. Since this change of resistance is a complex function of the magnetic field, this dissymmetry is also a complex function of the magnetic field. In each of these alloys the Hall effect is at first positive as in iron, but reverses its direction and becomes negative as in nickel for sufficiently large magnetic fields. For magnetic fields less than about 11,000 gauss, an increase in the concentration of iron increases the Hall effect. With an increase in the concentration of iron the maximum in the curve showing the Hall e.m.f. as a function of the magnetic field shifts toward greater magnetic fields. The greater the concentration of iron, the larger is the magnetic field at which a reversal in the direction of the Hall e.m.f. takes place. Each of the Hall-effect curves can be resolved into two component curves, one negative, the other positive. The negative component is a straight line, with a slope which is nearly the same for each alloy. This negative component may be attributed to the action of the magnetic field on the so-called free electrons. The positive component has the form of the corresponding curve for iron or nickel. The magnitude of this component increases with an increase in the concentration of the iron. The positive component may be attributed to the orientation of the elementary magnets by the transverse magnetic field. AUTHORS.

1967. Hall Effect with Extended Electrodes. E. Persico and F. Scandone. *Accad. Lincei, Atti*, 10. *pp.* 238–244, *Sept.*; 361–368, *Oct.*, *and pp.* 437–440, *Nov.* 3, 1929.

In the first two parts of this paper a mathematical investigation is given of the Hall effect in a rectangular lamina with primary electrodes extended on its two opposite sides and the extended secondary electrodes removed from the central position, the Hall effect being a maximum for secondary electrodes in this latter position. In the second part the Hall effect obtained when the secondary electrodes occupy any position on the margin of the rectangle is specially discussed. In the third part an experimental verification of the formulæ obtained is given. With the exception of one observation, the theory is in accord with experiment. J. J. S.

1968. Electrical Resistivities and Temperature Coefficients of Lead, Tin, Zinc and Bismuth in the Solid and Liquid States. W. B. Pietenpol and H. A. Miley. *Phys. Rev.* 34. *pp.* 1588–1600, *Dec.* 15, 1929.

A method of measuring the resistance-temperature coefficients of low melting-point metals in the solid and liquid states is described. The resistivity-temperature curves are shown for the metals (Pb, Sn, Zn, Bi), and the resistance-temperature coefficients are given for 20° intervals throughout the range 20° to 460° C. The temperature coefficients of resistance of zinc above the melting point are found to be positive instead of negative, as reported by Northrup and Suydam. Variations in the resistivity values indicate that there are allotropic transformations in zinc slightly above 180° C. and at about 340° C. The coefficients of the metals investigated are all positive, except those for non-annealed bismuth in the regions 160° to 180° C. and 225° to 275° C., and those for annealed bismuth in the latter region. The high resistivity values of non-annealed bismuth below 160° C. are attributed to three possible factors: (*a*) lack of random orientation of the crystals; (*b*) cracks and imperfections in the crystal lattice; and (*c*) amorphous solid bismuth which may be formed between cleavage faces and in re-entrant angles. The origin of these factors is accounted for by a crystalline transformation, in the region 160° to 180° C., which gives rise to them only when the metal is cooled rapidly. In the range 225° to 275° C. the negative coefficients of bismuth are due to a molecular derangement of the metal as it approaches the melting point and passes from the solid to the liquid state. [See also Abstract 964 (1928).] AUTHORS.

1969. Thermal and Electrical Properties of Beryllium. E. J. Lewis. *Phys. Rev.* 34. *pp.* 1575–1587, *Dec.* 15, 1929.

The specific heat of beryllium was obtained from cooling data by equating the heat loss per cm. length per unit time from berylluim to that from zinc. The values obtained increase rapidly with a rise in temperature from 0·0389 at − 175·6° C. to 0·593 at 190° C. The modified Forbes method of Bidwell was used to determine the thermal conductivity of this metal. Values of *k* were calculated with three different sets of distances from the first junction as origin for each run at a given surrounding temperature. *k* was found to increase with a rise in temperature from 0·232 at − 176·2° C. to 0·508 at 190·4° C. The specific resistance varies according to the heat treatment of the sample. Values recorded in this article are those obtained after a steady condition had been established after repeated treatments from liquid air temperature to 700° C. Measurements made on two samples check each other closely. They are: 1·56 microhms at − 191° C.; 6·76 microhms at 22° C.; 19·05 microhms at 305° C.; and 40·00 microhms at 690° C. The temperature coefficient of resistance, *a*, is not a constant over the above range. It increases with a rise of temperature, but not linearly. The graph of this quantity plotted against temperature shows three distinct sections, α has the following values: 0·000371 at − 190° C.; 0·00667 at 20° C.; 0·00800 at 310° C.; 0·00858 at 500° C.; and 0·01196 at 685° C. The thermoelectric power of beryllium against lead seems to vary linearly with temperature. However, at − 50° C. the graph of the thermoelectric power plotted against temperature shows a break. This, considered in connection with the results obtained for the temperature coefficient of resistance, suggests the probability of a change in allotropic form. The Wiedemann–Franz–Lorentz law, that $k/\sigma T$ is a constant, is not obeyed by this metal. AUTHOR.

1970. Thomson's Theorem of Minimum Heat. M. Lelli. *Accad. Lincei, Atti*, 10. *pp.* 368–371, *Oct.*, 1929.

A discussion of W. Thomson's theorem and its application to certain electrical problems. It is pointed out that under some aspects the theorem can have a more extended significance than is usually attributed to it.

J. J. S.

1971. Investigation of the Field in the K-Shell by Means of Hydrogen Rays. C. Gerthsen. *Ann. d. Physik*, 3. 3. *pp.* 373–408, *Oct.* 30, 1929.

The investigation of single H-nuclei in solid bodies previously carried out [see Abstract 266 (1929)] was limited to atoms of low atomic number. The work has now been extended and the experimental methods developed to apply to other atoms. Measurements of the dependence of the angle of scattering in manganese on the nuclear distances, which extend beyond Bohr's K-shell, are here also, within the discrepancies of up to 10 %, in agreement with Rutherford's theory of scattering. The observed systematic departures from the theoretical values are traced to the effect of the K-electrons. This is discussed. A. W.

1972. Light Produced by Electron Collision. W. Hanle. *Phys. Zeits.* 30. *pp.* 901–904; *Disc.*, 904–905, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

An account of measurements of the output of light in discharges in gases at very low pressure and with very small current density. The magnitude of the output of light of definite spectral lines with definite electron velocities, *i.e.*, the absolute output, was measured. Results are given in the case of certain lines of mercury vapour, helium and neon. The excitation functions are also given. J. J. S.

1973. Conditions near the Kathode of a Glow Discharge. Nora M. Carmichael and K. G. Emeléus. *Phil. Mag.* 8. *pp.* 909–918, *Dec.*, 1929. *Supplement.*

A preliminary account of an investigation of the region of the kathode glow and primary dark space with an exploring electrode. The form of tube used is illustrated and described, and the experimental procedure is given. It is of fundamental importance to know if an ionic sheath forms round a collector in the kathode dark space, and the problem can be approached directly from the experimental side by visual observation and from the shape of the characteristic curves. The authors give their reasons for employing the second method. The conditions are too complicated for a mathematical formulation of their ideas, but the course of the characteristic curves is accounted for qualitatively, although it is difficult to explain certain breaks in the curves. The results of the discussion are given, and there is a short summary of deductions drawn from the characteristic curves. T. C. H.

1974. Potential Distribution across the Kathode Dark Space. W. L. Brown and E. E. Thomson. *Phil. Mag.* 8. *pp.* 918–942, *Dec.*, 1929. *Supplement.*

A shadow is cast towards the kathode by an obstacle placed in the kathode dark space, and the authors investigate the effect of applying a potential to the obstacle. A series of observations were carried out, using obstacles (or collectors) of different shapes. Metals were used for all the electrodes. The results of observations using as collector a wire 0·4 mm. diameter mounted parallel to the kathode surface are briefly summarised. The conclusion that the potential of the collector, when the shadows thrown to the two sides of it are equal in width, is the potential of the surrounding space is used as a basis for measuring the potential distribution across the kathode dark space. Some preliminary observations are discussed, and are followed by a description of the experimental arrangements. The results are considered at some length, and data obtained with different gases under various conditions of pressure and voltage are given in a table. Some typical graphs are also shown and explained. A discussion follows on the space charge, and a short summary concludes the paper. T. C. H.

1975. Oscillations in Low-Pressure Discharge Tubes. E. W. B. Gill. *Phil. Mag.* 8. *pp.* 955–960, *Dec.*, 1929. *Supplement.*

The discharge tube used was cylindrical and contained two small circular electrodes about 1-cm. diameter, whose distance apart could be varied. The tube was shunted by a variable condenser and a discharge passed through the tube from a d.c. high-voltage dynamo, the current being regulated by passage through a diode with controlled filament current. It was found that up to a limiting current of 2 or 3 milliamperes the discharge, over a large range of pressures, produced oscillations varying in frequency from a few to about 150,000 per sec., the oscillations being very rich in harmonics. With increased pressure the wave-length was found to increase slightly. A greater increase was found with increased electrode distance. When the current through the tube is varied, other conditions being constant, the product of current and wave-length is approximately constant. With varying capacity a linear relation is found between wave-length and capacity. A theoretical explanation of the observed effects is given. A. W.

1976. Gas Discharge in Hydrogen. Part I. E. Lau and O. Reichenheim. *Ann. d. Physik*, 3. 6. *pp.* 840–848, *Dec.* 4, 1929.

The discharge in hydrogen has been studied over the range of pressures of 0·7–0·1 mm. The gas streamed through the discharge tube at the rate of approximately 1 m./sec. The results show that the occurrence of the stratified discharge is brought about by the recombination of dissociated hydrogen to form a negatively charged hydrogen molecule. This conclusion is in agreement with earlier work, which showed that electronegative gases tend to give a stratified discharge. The recombination of dissociated hydrogen is catalysed by various solids; an attempt has been made to measure their effect as catalysts by the number of stratifications they give rise to under given conditions of discharge. The efficiency of carbon, iron, copper and aluminium as catalysts is proportional to the numbers, 26, 19, 14 and 12 respectively. F. J. W.

1977. Temperature Measurements in the Mercury-Vapour Discharge. E. Lübcke. *Zeits. f. techn. Physik*, 10. 12. *pp.* 598–603, 1929. *Paper read before the Deut. Math. u. Phys., Prague*, 1929.

The relation between the electronic temperature and vapour pressure has been studied by the method of Langmuir. It is found that the logarithm of the electronic temperature is a linear function of the vapour pressure. The temperature of the mercury vapour in various parts of the tube was measured with a thermocouple. The values obtained when the thermocouple was sheathed with a glass capillary were higher than those obtained with the unprotected thermocouple. The higher values are probably correct. In the neighbourhood of the electrodes, with an arc current of 13 amperes, temperatures as high as 450° C. were obtained. The electronic temperatures are between 7000° and 45,000° K. F. J. W.

1978. Spiral Form in Gas Discharges. S. P. McCallum and W. T. Perry. *Nature*, 124. *pp.* 984–985, *Dec.* 28, 1929.

The exact conditions under which spiral discharges occur in neon and argon with slight impurity of metallic vapour. The precise mechanism is unknown. W. V. M.

1979. Columnar Ionisation in Gases at High Pressure. G. Jaffé. *Phys. Zeits.* 30. *pp.* 849–856, *Dec.* 1, 1929.

According to the author's theory of ionisation in columns [see Abstract 2565 (1929)] a very marked effect of the pressure on the form of the saturation curve for ionisation by α-rays is to be expected. Accordingly an experimental investigation was made of the saturation curves for several different gases at pressures up to about 6000 mm. of mercury. The results obtained throw some light on the dependence of the coefficient of recombination on the pressure. The behaviour of the saturation curves is found, over a wide range of pressure, to be in quantitative agreement with the theory previously given. The recombination coefficients for all the gases dealt with (air, oxygen, hydrogen and CO_2) were found to decrease with increasing pressure, the decrease, except in the case of hydrogen, being very appreciable. A. W.

1980. Ionisation of Gas by Positive Ions. Secondary Emission of Platinum. T. I. Câmpan. *Phys. Zeits.* 30. *pp.* 858–865, *Dec.* 1, 1929.

An investigation was made of the ionisation of hydrogen and nitrogen by positive K-ions emitted from a Kunsman electrode of potassium-iron oxide with velocities due to voltages up to 140 volts The method used was the retarding field method of Lenard, the pressures ranging from 0·0003 to 0·1 mm. of mercury in the case of hydrogen, and from 0·0003 to 0·054 mm. for nitrogen. It was found that the order of magnitude of the ionisation produced by K-ions is only 0·01 %; hence, the retarding field method is unsuitable for such investigations, since this small amount of ionisation is masked by much stronger secondary effects. The impact of positive K-ions on platinum gives rise to a secondary emission which begins with very small velocities of the positive ions. At 28 volts the secondary emission is about 0·01 % and rises to 1·1 % at 128 volts. This secondary emission is much increased when the surface of the metal is covered with an adsorbed layer of nitrogen molecules and disappears when the metal is degassed. A. W.

1981. Phase Theory in Thermionics. O. Halpern. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 8. *pp*. 625–627, 1929.

A metal is considered to be a two-component system consisting of ions and electrons. On this basis it is shown that contact potentials are to be expected at transition points. F. J. W.

1982. Secondary Emission. K. Sixtus. *Ann. d. Physik,* 3. 8. *pp*. 1017–1054, *Dec*. 23, 1929.

The secondary emission occurring when electrons in a thermionic valve strike the various conductors has been examined. It has been noted that materials which are good emitters are also liable to give copious secondary emission. In the first part, a number of commercial (German) valves are examined; whilst in the second part of the paper, special tubes were made, with the object of studying the relation between the secondary emission and the capacity for primary emission. Among other results it is noted that the magnitude of the secondary emission is independent of the filament temperature in the range 300° to 1000° K. No definite relation exists between the secondary emission and the work required to remove an electron, in the case of oxide-coated electrodes. J. H. A.

1983. Emission of Electrons from Conductors under Intense Fields. P. W. Bridgman. *Phys. Rev.* 34. *pp*. 1411–1417, *Dec*. 1, 1929.

With the classical picture of the electron, a thermodynamic discussion is given of the current drawn from metals by intense fields, using the Volta difference of potential between two metals to produce the intense field. It is found that the order of the metals arranged according to the magnitude of their field currents is the same as their order arranged according to their Volta potential differences. It is also found that the density of the electron atmosphere in equilibrium with the metal is the same with a given field whether the direction of the field is such as to drive the electrons towards the metal or to pull them away from it. The modifications demanded in these conclusions by the wave-mechanics picture of the electron are briefly discussed; it seems probable that the first result will stand, but that the second would have to be much modified, the precise method of modification not being now evident. In connection with the present wave-mechanics picture it is suggested that the potential discontinuity imagined to be encountered by all of the electrons in leaving the metal may be statistical in character. Expressions are given for the change in heat of evaporation of electrons and in the photoelectric threshold efficiency produced by intense fields in terms of a slight change of Volta difference. Attention is called to a temperature correction which should be applied to various experimental determinations which will have the effect of making the field current not absolutely independent of temperature at low temperatures, as has been supposed. AUTHOR.

1984. Effect of Light on Electron Emission from Oxide-Coated Filaments. K. Newbury. *Phys. Rev.* 34. *pp*. 1418–1425, *Dec*. 1, 1929.

The increase in electron emission from oxide-coated platinum filaments when light is focussed on them was studied as a function of applied potential, filament temperature, and wave-length of the incident light. The effect was zero at zero applied field, but reached a saturation value at from 2 to 10 volts depending on the thickness of the oxide coating. At an applied potential sufficient to give saturation the effect increased with filament temperature up to about 1000° C., and then became less for higher temperatures. The long wave-length limit of the effect was about 4000 Å. There is a sharp increase in sensitiveness for wave-lengths less than about 2500 Å. These facts all find an adequate explanation if it be assumed that the normal photoelectric emission from the oxide coating of the filament so modifies the distribution of its intrinsic surface field as to alter the effect of the externally-applied field on the work function of the surface.

AUTHOR.

1985. Effect of Light on Electron Emission from Cerium Dioxide. C. E. Berger. *Phys. Rev.* 34. *pp.* 1566–1574, *Dec.* 15, 1929.

Ultra-violet light was found to increase the electron emission from hot filaments coated with cerium dioxide, or thorium oxide, or calcium oxide, or calcium iodide. In the case of cerium dioxide on platinum at about 1000° C. the photo-emission varied linearly with the intensity of the ultra-violet light; wave-lengths above 3000 Å. were not effective. Air, hydrogen, or oxygen, in small amounts, caused a decrease in the photo-emission. The saturation photo-currents showed distinct increase with increase in temperature. Sufficient evidence was not obtained to decide whether this constitutes a variation of the true photoelectric effect with temperature or whether some other cause operates, such as change of surface by bombardment.

AUTHOR.

1986. Red-Sensitive Sodium Photo-Kathodes (Photoelectric Cells). P. Selényi. *Phys. Zeits.* 30. *pp.* 933–935, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

Starting with a cell consisting of a film of sodium deposited on the cell wall as kathode, and a tungsten spiral as anode, activation to increase sensitivity and extend the long-wave limit (560–570 $m\mu$) towards the red, was accomplished (*a*) by depositing a thin film of nickel on the sodium, (*b*) by introducing a small quantity of oxygen (which immediately forms an oxide layer on the sodium), employing a special process involving the electrolysis of the glass. In the former method only a temporary activation is attained as the sodium in the course of a day or two diffuses back to the surface. With the latter method an "activated" life of three to four months is attained. A number of preliminary measurements on the spectral sensitivity curve, which shows a secondary maximum besides the displacement towards the red, and on the relation between light intensity and photoelectric current, are reported.

W. S. S.

1987. Photoelectric Effect and Electric Surface Peculiarities of Various Metals. R. Suhrmann. *Phys. Zeits.* 30. *pp.* 939–942; *Disc.*, 942, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

When a piece of platinum foil containing hydrogen is caused to glow in a high vacuum its photoelectric sensitiveness is increased. This was confirmed by experiments on a photoelectric cell whose kathode was formed of thin sheets of Au, Ag or Pt, the cell being filled with H at 0·01 to 0·001 mm. pressure. When hydrogen ions were produced by a glowing wire in the neighbourhood and drawn on to the kathode of Au or Ag by an electric field the loading with H-ions increased the photoelectric sensitiveness of the surfaces. Pt foil rendered insensitive by electron bombardment had its sensitiveness increased by being caused to glow for a few seconds in a high vacuum at about 1000° C., H-ions and probably also H-atoms coming from its interior on to its surface.

J. J. S.

1988. Differences in the Directions of Ejection of X-Ray Photoelectrons from Various Atomic Levels. E. C. Watson and J. A. van den Akker. *Roy. Soc., Proc.* 126. *pp.* 138–143, *Dec.* 2, 1929.

By means of the magnetic spectrograph an investigation was made of the directions of ejection of electrons from different atomic levels. The experimental results indicate that: (1) The distribution in space of the photoelectrons thrown out of the L_{II} and L_{III} levels by any given X-radiation is more isotropic than that of the electrons thrown out of the K or L_{I} levels by the same radiation, appreciable numbers of the L_{II} and L_{III} electrons being ejected even in the forward and backward directions. (2) The angle at which photoelectric ejection is a maximum is smaller (and very appreciably smaller) in the case of the L_{II} and L_{III} electrons than in the case of the K and L_{I} electrons, or, in other words, the average forward momentum of the L_{II} and L_{III} electrons is greater than that of the K and L_{I} electrons. An effect of the binding energy of the electron upon the direction of ejection is shown. An increase in the binding energy increases the angle at which the ejection is a maximum, or decreases the average forward momentum of the photoelectrons. Photographs of magnetic spectra are given. J. J. S.

1989. Scattering of Positive Lithium Ions in Mercury Vapour. I. W. Cox. *Phys. Rev.* 34. *pp.* 1426–1437, *Dec.* 1, 1929.

The number of positive lithium ions passing through a fixed distance was observed with different pressures of mercury vapour. The rate of absorption deduced was found to depend on the aperture of the apparatus. This indicates that the absorption is due largely to small angle scattering of the ion at a collision with a mercury atom. This scattering is incompatible with that due to elastic collisions. A computation with a law of electrostatic repulsion gives a dependence of absorption on aperture in qualitative agreement with the observations. AUTHOR.

1990. Large Ions. A. Véronnet. *Comptes Rendus*, 189. *pp.* 1249–1251, *Dec.* 30, 1929.

A further development of the electronic theory of the ether [see Abstract 3621 (1929)]. In an ionised gas, a free electron is captured by a neutral atom when it approaches sufficiently near. It becomes a negative ion, and attracts neutral atoms with the same force as the free electron. This attraction is proportional to the square of the electronic charge and of the radius of the orbit, and inversely proportional to the fourth power of the distance. The neutral atoms or molecules arrange themselves in successive layers round the ionised atom. The pressure of the first layer is calculated at 20,000 atmospheres for the hydrogen atom, and 340,000 for nitrogen and oxygen. The pressure of the second layer is sixteen times smaller. Large ions or droplets are thus formed, which may explain many atmospheric and cosmic phenomena. E. E. F. d'A.

1991. Scattering of Single Electrons. O. Klemperer. *Ann. d. Physik*, 3. 7. *pp.* 349–378, *Dec.* 18, 1929.

With Geiger's counter the angular distribution of separately scattered electrons was investigated for electrons of velocity of 18 and 9 kV, by means of scattering leaves of celluloid, aluminium and beryllium. The Geiger counter closed with a window of thin celluloid registers single electrons with an economy which falls off very little with electron velocity, decreasing from 18 to 5 kV, but decreases rapidly from 5 kV. The angular distribution found experimentally is very much flatter than that of the scattered α or canal rays. It is not exactly explained by any of the present theories. The course of the distribution of scattering with large angles of deviation supports the hypotheses of wave mechanics as to spin and relativistic change of mass of the electron rather than the classic-relativistic calculations of Darwin. By means of an electric cross field it was possible to distinguish two groups of velocities amongst the scattered electrons which are designated as nucleus scattered electrons, with the original velocity, and electron scattered electrons which experience a loss of velocity corresponding with the magnitude of the angle of deflection. The X-radiation emerging from the scattering sheets is very feeble compared with the scattered electron radiation. The angular distribution of the manifold scattering was determined by the multiplication counter, and thereby the diffraction maxima of the matter waves were again found. The output of scattered electrons in the case of large angles of deflection is correctly expressed as to order of magnitude by the Rutherford formula. J. J. S.

1992. Regular and Total Reflection of Electrons. E. Rupp. *Phys. Zeits.* 30. *pp.* 935–939, *Dec.*, 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The measurements show that as the angle of incidence decreases the proportion of electrons reflected at the equal angle of reflection increases (silver); that the electrons reflected regularly without energy loss increase in quantity with decrease in electron velocity, the angle of incidence being kept constant; that for elements in the same vertical column of the periodic table the intensity of the reflection maximum increases with decreasing ordinal number. Definite experimental proof of total reflection of electrons is provided by an experiment in which the incident beam impinges on a thin wedge of nickel deposited on a metal (Cu) or insulator (KCl). On displacing the reflecting surface so that the point of incidence moves along the metal wedge, the intensity of the reflected electrons shows, for angles of incidence in the neighbourhood of 80°, a characteristic maximum which is due to total reflection of the electrons at the interface Ni-Cu or Ni-KCl respectively. W. S. S.

1993. Space and Surface Lattice Interference with Electrons in Mica. E. Rupp. *Zeits. f. Physik*, 58. 11–12. *pp.* 766–768, 1929.

The type of interference pattern obtained with a sheet of mica 10^{-5} cm. thick subjected to an electron current at 15,000 volts is that of the surface lattice with a strong current, and conforms with the space lattice when the current is weak. G. E. A.

1994. Interferometric Observation of Oscillating Quartz Plates. H. Osterberg. *Nat. Acad. Sci., Proc.* 15. *pp.* 892–896, *Dec.*, 1929.

The oscillating plate is made one mirror of a Michelson interferometer. When parallel fringes are produced by inclining one mirror, the fringes are located on the surface of the mirror, and vibrations normal to the surface are indicated by movements of the bands. A number of photographs of the effect are reproduced. F. S.

1995. Application of the Valve Voltmeter to the Analysis of Harmonics. C. G. Suits. *Helv. Phys. Acta*, 2. 7. *pp.* 492–508, 1929. *In German.*

The employment of a valve voltmeter method for the analysis of complex electric waves is explained. The sensitiveness and the accuracy of the arrangement are shown from measurements of the wave-forms of known harmonics. The accuracy is about 1 % for harmonics with an amplitude of 10 % of the fundamental amplitude, and about 3 % for those whose amplitude is 1 % of the fundamental amplitude. Examples are given with the relative oscillograms of various applications of the method. Sources of error and limits of sensitiveness are considered. J. J. S.

1996. Refraction of Damped Electric Waves at a Dielectric Cylinder. I. Kobayashi. *Ann. d. Physik*, 3. 6. *pp.* 721–736, *Dec.* 4, 1929.

A theoretical treatment is given. The incident wave is assumed to be a plane wave train which suddenly assumes the form of a damped wave of sine form. The effect of the wave head not being incident on the different parts of the cylinder simultaneously is obtained in the form of an integral. The intensity behind the cylinder is also calculated. A. W.

1997. Magnetic Behaviour of Nickel and Iron Films Condensed in Vacuum upon Various Metal Backings. J. H. Howey. *Phys. Rev.* 34. *pp.* 1440–1447, *Dec.* 1, 1929.

The magnetic nature of evaporated iron and nickel films deposited on various kinds of backings was investigated to determine the effect of the two-dimensional strain which the backing must impose upon the film due to differential thermal contraction. The films were, of necessity, deposited at elevated temperatures and measured at room-temperature. The temperature of deposit was varied. Nickel samples deposited on backings which place the film under tension were found to be extremely hard, magnetically, while compression made the film comparatively soft. The magnetic intensity of iron samples in general was not changed markedly by these stresses. All the samples were harder than bulk metal. The method used to describe the results shows that films deposited at higher temperatures are more like annealed bulk metal, rather than less so as others have concluded. Extreme precautions were taken to deposit the films under gas-free conditions so that it was possible to be sure that the abnormal hardness of films deposited at ordinary temperatures was due to the different manner in which the metal condenses and not due to the presence of gas. A novel arrangement of the magnetising coil of a sensitive astatic magnetometer used for the magnetic measurements is described. AUTHOR.

1998. Barkhausen Effect. F. Preisach. *Ann. d. Physik*, 3. 6. *pp.* 737–799, *Dec.* 4, 1929.

An investigation of the course of the magnetisation curve and its dependence on certain factors, such as elastic condition. The paper is in four parts; in the first part, the hysteresis cycle is investigated as to its relation to the Barkhausen effect. The form of the cycle arises from an overlapping of continuous and discontinuous processes. There is a parallelism between reversible and continuous changes, and between irreversible and discontinuous ones, but complete identity has not been established. Further, there is no simple relation between the slope of the magnetisation curve and the Barkhausen effect. The magnitude of the discontinuities varies within wide limits, and a general physical interpretation of this cannot be provided. The second part deals with the effect of previous treatment and of the elastic state on the magnetisation process. For a series of iron-nickel alloys with 8 to 100 % of nickel sudden magnetic changes may be regulated by appropriate elastic treatment. Torsion increases the discontinuities in all the alloys, and causes the appearance of the rectangular hysteresis graphs described by Forrer [see Abstract 2158 (1925)]. G. E. A.

1999. Anomaly in the Diamagnetism of Gases. Part V. A. Glaser. *Ann. d. Physik*, 3. 8. *pp.* 1119–1136, *Dec.* 23, 1929.

Critically discusses sources of errors in previous methods of measuring the diamagnetic properties of gases. The objections to the methods can be divided into two groups, both of which are due to suppositions made by previous authors. In the first group are to be found the anomalies caused by a probable influence of the adsorption of gases or water vapour on the outer surface of the small exploring point which is used for susceptibility measurements. The second group contains the anomalies caused by temperature differences, which are thought to exist between different parts of the apparatus. Finally, the question of adsorption and the effect of water-vapour are experimentally examined. [See also Abstract 3656 (1929).] R. C. F.

2000. Diamagnetism of Solid Bismuth. P. Ehrenfest. *Zeits. f. Physik*, 58. 11–12. *pp.* 719–721, 1929.

The view is advanced that the abnormally high diamagnetism of solid bismuth (liquid bismuth is quite normal) is due to electron orbits which have a definite orientation in the crystal lattice, and which encircle more than one atom of the lattice. W. S. S.

2001. Susceptibility of NO Gas at Different Temperatures. J. Aharoni and P. Scherrer. *Zeits. f. Physik*, 58. 11–12. *pp.* 749–765, 1929.

Measurements of the mean number of magnetons in the NO molecule found from observations of NO at 17° C. and — 78·5° C. are in agreement with van Vleck's theory [see Abstract 986 (1929)], according to which the number diminishes with the temperature to disappear at absolute zero. G. E. A.

2002. Effect of Crystalline Structure on Magnetic Susceptibilities. S. S. Bhatnagar and R. N. Mathur. *Phil. Mag.* 8. *pp.* 1041–1055, *Dec.*, 1929.

The magnetic susceptibilities of rhombic and monoclinic sulphur, and of yellow and red mercuric iodide were determined by means of a specially designed magnetic balance. The principle of the balance was interference of light, and allowed the interference fringes to be measured with great accuracy. The materials were contained in a phial suspended on the beam of the magnetic balance. The phial containing the material was turned by a magnetic field, and the turning caused a glass plate to turn through an angle. This caused a system of interference fringes to shift, and coincidence was restored by rotating the interferometer screw. The amount of rotation of the screw was read off from the scale. Attempts were made to measure the magnetic susceptibility of plastic sulphur. F. J. B.

2003. Magnetic Properties of Mesomorphic Substances. G. Foëx. *J. de Physique et le Radium*, 10. *pp.* 421–438, *Dec.*, 1929.

Most of the measurements were made in a field of about 8000 gauss. Ferromagnetic impurities were eliminated by filtration from solution in chloroform and recrystallisation. The coefficients of magnetisation were measured by Faraday's method (repulsion in a non-uniform field). The powdered solid and the isotropic liquid have a diamagnetism independent of the temperature. For the nematic phase the susceptibility is smaller and increases with the temperature. The smallness is due to the molecules possessing a common direction and the increase to thermal agitation destroying the orientation. In certain cases the measurement of the coefficients of magnetisation enables the orientation of the molecules to be found. This orientation has been completely determined for the crystal of para-azoxy-anisol. Investigation by diamagnetism supplements or completes that carried out by means of X-rays. The theory of diamagnetism and the behaviour of the electron are discussed in the paper, and the structure of the molecule is considered. The result obtained in the last case is purely qualitative. It shows that the exterior electronic orbits contained in planes parallel to the chain of the atoms are preponderant. By means of a complete theory of diamagnetism quantitative results on the distribution of the exterior orbits in the molecule could be obtained. When this distribution was known data could be obtained on chemical combination and on various optical questions. J. J. S.

2004. Laws of Approach to Absolute Saturation of Ferromagnetics in Terms of the Field and the Temperature. P. Weiss and R. Forrer. *Ann. de Physique*, 12. *pp*. 279–372, *Nov.*, 1929.

The paper contains a description of the method employed in an accurate measurement of the magnetisation of ferromagnetic substances in intense fields and at low temperatures. The laws of approach to saturation as a function of the field, and to absolute saturation of a function of the temperature, are discussed. The significance of these laws is examined with reference to the mechanism of magnetisation, and of the latter from the point of view of Nernst's postulate that entropy is finite at absolute zero. The atomic moments of Fe and Ni are given as 11 and 3 magnetons to about 1 part in 1000, the Weiss magneton used as unit being 6·3 per 1000 greater than the fifth part of a Bohr magneton. The moment of the ferric iron atom in magnetite is 10·10 magnetons, a part of the excess over the whole number being explained by the paramagnetism which accompanies the ferromagnetism in Fe_3O_4. The atomic moments of iron in Fe_3C, Fe_2B, Fe_2O_3 and pyrrhotine are respectively 9, 9, 9 and 2 magnetons. Alloys of ferrocobalt containing 35 to 45 % Co have a saturation value more than 12·4 % greater than that of pure iron. In α-ferrocobalt and γ-nickel-cobalt, the Co is present in the 9-magneton state; in hexagonal nickel-cobalt the Co has $8\frac{1}{2}$ magnetons, whilst in γ-ferro-cobalt and in pure γ-cobalt a moment of $8\frac{2}{3}$ magnetons is probable. Two new effects are described, *viz.*, a parasitic magnetisation of nickel and a discontinuity in the magnetisation of magnetite which occurs at 120° K. [See also Abstract 983 (1929).] G. E. A.

2005. Operational Solution of Linear Differential Equations. B. van der Pol. *Phil. Mag.* 8. *pp*. 861–898, *Dec.*, 1929. *Supplement.*

The earlier work on operators by various authors and some general theorems in connection with the operational method are considered. Heaviside's "impulsive" function $p[1]$ is shown to be identical with Dirac's $\delta(x)$ function. Then, some of the general operational theorems are considered in more detail, especially the meaning of $e^{-\lambda p} . f(p)$. Some examples of the solution of differential equations with constant coefficients are considered, and, then, linear differential equations with variable coefficients are discussed. Three new integral expressions for the derivation of a Bessel function $J_n(x)$ with respect to its order n are discussed. Operational expressions for Legendre, Laguerre and Hermite's polynomials are obtained, and, finally, some general considerations on operators are given. J. J. S.

2006. Electronic Waves. J. J. Thomson. *Phil. Mag.* 8. *pp.* 1073–1092, *Dec.*, 1929.

In a former paper [see Abstract 1612 (1929)] the author considered the electronic waves accompanying an electron moving uniformly in a straight line. In the present paper the waves are considered in the general case when the electron is under the action of an electric force, so that its velocity and direction of motion are changing. The point of view taken is that the distribution of the sub-electrons in the atmosphere of the electron is affected by the electric force, so that the waves are no longer moving through a uniform medium, but one whose properties vary from point to point. It is shown that in this case both the electric and magnetic forces in the electronic waves are at any point at right-angles to the path a point electron would describe under the action of the electric force. As the direction of propagation of the waves is at right angles to both the electric and magnetic forces, the waves are always travelling along what would be the path of the point electron. When the latter is not a closed curve there is radiation of energy, unless the velocity of the electron is uniform; when closed, the energy in the waves moves round and round the curves, none of it gets loose and there is no radiation. The distribution of electric waves when an electron passes through a crystal is calculated. H. H. Ho.

APPARATUS AND INSTRUMENTS.

2007. Increasing the Sensibility of the Dolezalek Type of Electrometer and a Direct-Reading Null Circuit. J. M. Pearson. *J.O.S.A. and R.S.I.* 19. *pp.* 371–377, *Dec.*, 1929.

The needle of the electrometer is set at an angle to its suspension, so that it does not hang in a horizontal plane. The quadrants are then tilted out of the horizontal, but with the lines of greatest slope perpendicular to the centre line of the needle. It is shown that this must increase the sensitivity, without causing instability. An instrument giving normally 800 mm./volt could be made to give 8000 mm./volt by these alterations. A circuit is described by which the electrometer may be used for measurement of currents from 10^{-15} to 5×10^{-9} ampere. J. H. A.

2008. Quartz Suspension Galvanometer for Use in D.C. and A.C. Circuits. D. R. Barber. *Phil. Mag.* 8. *pp.* 1106–1112, *Dec.*, 1929.

This is a moving-iron reflection instrument of special design. A rhomboidal beam of quartz rod, 1 mm. diameter, carries at its extremities two soft iron wires bent into arcs of radius 2·5 cm. and length 1·5 cm. The iron wires are able to move in a horizontal plane within two solenoids, consisting of a pair of telephone bobbins, total resistance 2000 ohms. The whole of the rotating framework is rigidly attached to a quartz fibre, diameter 10 μ, length 3·2 cm., which is stretched between the two extremities of a rectangular quartz frame. A concave mirror attached to the moving system enables the deflection to be read by the lamp and scale method. The period of the complete moving system is 5·5 sec. Calibrated with d.c. the deflection is proportional to the current; with a.c.

the deflection is proportional to the logarithm of the deflection. In the latter case there is a small residual deflection with zero current, the effect of which is attributed to eddy currents in the solenoid coils. The range of the instrument is 10^{-3} to 10^{-6} ampere. W. C. S. P.

2009. Galvanometer Calculations. Michel. *Comptes Rendus*, 189. *pp*. 1257–1259, *Dec*. 30, 1929.

The author discusses the factors governing the sensitivity (P) of a galvanometer and arrives at an expression, involving the resistances of the whole circuit (R) and of the coil (r), the restoring couple (C) for unit angular displacement, the free period (T) and the ratio (m) of the magnetic fields when the coil is respectively dead beat and aperiodic, taking the form $P = \frac{T}{4\pi C(R - r)} \times \frac{\sqrt{3m} - 1}{\sqrt{3m}}$. P will be a maximum when the coil and mirror have their smallest values while satisfying this relation. R. S. R.

2010. Cryo-Magnetic Apparatus for Measuring Susceptibilities at Low Temperatures. E. C. Wiersma and H. R. Woltjer. *K. Akad. Amsterdam, Proc*. 32. 8. *pp*. 1046–1053, 1929. *Comm. No*. 201*c of the Phys. Lab., Leiden.*

The cryo-magnetic apparatus is similar to that designed by Weiss. The specimen is fixed to the end of a glass rod suspended horizontally by two wires. The non-homogeneous field of an electromagnet drags the specimen between the poles. This force is balanced and measured by the use of three coaxial coils carrying currents, one coil being attached to the glass rod, and the two others fixed to the bench. Full details are given of the vapour cryostat for maintaining the specimen at a low temperature. The cooling is effected by passing round the specimen the cold vapour from liquid air or hydrogen. A. A. D.

2011. Moment of Inertia of a Magnet and its Suspension. C. R. Duvall. *Terr. Mag*. 34. *pp*. 303–308, *Dec*., 1929.

A method of computation of the moment of inertia of a magnetometer magnet is developed which gives a considerable saving of time over the method generally used. The reduction formula is transformed so that the whole computation may be made by the differential method. AUTHOR.

2012. Inductances of High Permanence. W. H. F. Griffiths. *Journ. Sci. Instruments*, 6. *pp*. 354–357, *Nov*., 1929.

The design of inductances for use in substandard wavemeters and for other radio-frequency purposes is discussed and suitable inductances are described. AUTHOR.

2013. New Variable Standard of Electromagnetic Induction. P. E. Klopsteg. *J.O.S.A. and R.S.I*. 19. *pp*. 367–370, *Dec*., 1929.

After a brief survey of methods of flux measurements the author describes an instrument combining the simplicity of the Hibbert inductor with the range of current inductors. The instrument has the magnet, core and pole-pieces of an electric meter and a moving coil which acts as a generator. A ring of bakelite coaxial with the coil, and having an attached mechanism for rotating it, turns it to any selected position in the magnetic field. It is released by a button, and the coil on returning to the zero stop is held there by another catch. The methods of calibration and use are described. An accuracy of 0·5 % is obtained, which is greater than in ordinary current inductor methods. R. S. R.

2014. Simplification of Coincidence Counting. W. Bothe. *Zeits. f. Physik*, 59. 1–2. *pp.* 1–5, 1929.

A description is given of an arrangement by which the coincidences between the strokes of two electric counters, such as those of Geiger, can be automatically indicated and summed up. J. J. S.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2015. Ultra-Violet Radiation from the Sun and from Heated Tungsten. W. E. Forsythe and F. Christison. *Gen. El. Rev.* 32. *pp.* 662–667, *Dec.*, 1929.

The first part of the paper is a review of recent studies and calculations of the radiation from heated tungsten and from the sun. The energy in various parts of the spectrum of the sun is compared by means of tables and curves with that for some tungsten lamps. By extrapolation a wave-length range of $0 \cdot 27\,\mu$ to $0 \cdot 76\,\mu$ is obtained. The paper finally considers the ultra-violet radiation from quartz-bulb tungsten lamps and the therapeutic value thereof. A. J. S.

2016. Transmission in the Ultra-Violet of Paraffin-Coated Cloth. V. P. Lubovich and Margaret McC. Maltbie. *J.O.S.A. and R.S.I.* 19. *pp.* 411–415, *Dec.*, 1929.

With the increasing interest in the use of ultra-violet in therapy and otherwise a demand has arisen for inexpensive and easily obtainable substitutes for fused quartz. The materials considered in this paper are glass substitutes consisting of white cloth coated with paraffin. Various samples have been tested and in general transmit to within 50 Å. of 2300 Å. In the visible region they transmit, in general, less than 10 % of the incident light. The best results are obtained by coating white cheese-cloth with a very thin layer of paraffin wax. Radiation down to 2253 Å. was detected in the transmitted light. W. V. M.

2017. Quantitative Investigation of the Absorption Spectrum of Blood and its Constituents. R. Suhrmann. *Phys. Zeits.* 30. *pp.* 959–965; *Disc.*, 965, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

Accurate measurements of the extinction coefficient of human and animal blood and their constituents in the region of wave-lengths 240–480 $\mu\mu$. The differences observed in normal and rachitic rats are discussed and their importance is emphasised. The original should be consulted for the experimental details. W. V. M.

2018. Interferometer for the Investigation of the Processes of Growth. K. W. Meissner. *Phys. Zeits.* 30. *pp.* 965–971, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

An interferometer of the Michelson type is described having the following features: (1) Instead of the usual horizontal mounting the movement is vertical. (2) The one interferometer mirror is movable horizontally by means of a slot and screw, while the second may be moved vertically or by a sensitive Roberval balance arrangement so that it may be moved by very small forces (20–40 mgm. weight), such as those involved in plant physiological problems. (3) In place of the plane interferometer mirror a combination of curved mirrors (concave and convex) with a plane mirror is employed. The interference fringes are then concentric Newton's rings. By simple adjustments straight line interference bands may be obtained.

(4) With the help of an auxiliary scale achromatic interference fringes may easily be obtained, so that an objective demonstration by projection with white light is easily possible. W. V. M.

2019. Revival of the Heart by Soft X-Rays after its Arrest through Removal of Diffusible Potassium. H. Zwaardemaker and T. P. Feenstra. *K. Akad. Amsterdam, Proc.* 32. 10. *pp.* 1303–1304, 1929.

A heart after its arrest through the removal of its diffusible potassium can be revived by means of any corpuscular radiation of the right intensity. It is now shown that this effect can be obtained with Grenz rays, *i.e.*, very soft X-rays. For details the original should be consulted. W. V. M.

2020. X-Ray Emission from Thermionic Valves. J. F. Bromley. *Brit. J. of Radiology*, 2. *p.* 587, *Dec.*, 1929.

Soft X-rays have been observed from a valve used as rectifier, the intensity being sufficient for screening in a dark room. W. V. M.

2021. Acoustic Nerve Currents. C. Foà and A. Peroni. *Accad. Lincei, Atti*, 10. *pp.* 389–392, *Nov.* 3, 1929.

On account of the difficulty of operating with the nerves of the higher animals, the authors used the auditory nerves of reptiles. They put one electrode on the cut section of the auditory nerve of *Thalassochelis Carretta*, and the other on an indifferent part of the brain. They used a three-valve amplifier and an Einthoven galvanometer for detecting the currents, and three organ pipes of 16, 33 and 132 Hertz for producing the sounds. The results show that whatever the frequency of the note the electric response is always intermittent, with a frequency of 50 to 60 per sec. E. E. F. d'A.

2022. Electrogram of the Submaxillary Salivary Gland. A. van Harreveld. *K. Akad. Amsterdam, Proc.* 32. 10. *pp.* 1370–1378, 1929.

It has been shown that stimulation of the nerves, in relation to the submaxillary salivary gland, results in changes in potential in the gland. Past observers have published discordant results due to the use of instruments with large values of inertia. The present investigator has used a sensitive string galvanometer. The types of curve are illustrated and discussed, particularly with reference to the influence of atropine. The discussion is physiological rather than physical. The changes in gland resistance are apparently due not to changes of concentration but change of ionic mobility. The work of other investigators is discussed at length. B. J. L.

2023. Physics of the Living Cell. Part I. R. Fürth. *Phys. Zeits.* 30. *pp.* 951–957; *Disc.*, 957–958, *Dec.* 15, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

The task of biophysics is that of investigating the physical processes occurring in the living cell, and as in atomic physics the fine structure of atomic constitution is dealt with, so in biophysics the fine structure of living matter should be the subject of investigation, for which suitable physical methods of investigation are required. For the determination of the partition of potential, metal electrodes are not applicable and special electrodes of KCl in agar-agar (as first suggested by Ettisch and Peterfi) allow the use of electrodes of only 0·01 mm. diameter which are manipulated under the microscope. For measurement of potential, current instruments, even with a sensitiveness of 10^{-10} amp., are not applicable,

as even this small flow of current leads to polarisation and cell destruction. Therefore, for the purpose of potential measurement an electrostatic relay employing a double grid valve is used. This instrument is described and has a sensitiveness of 1 mV and a range of 0·1 V. A second indirect method of investigation is by the direct introduction into the cell of a "test body," as provided by particles of dyes of dimension 10^{-7} to 10^{-5} cm., whose movements are studied by means of an applied electric field, by observation of their Brownian motions and by their mechanical penetration. To determine the charge upon the particles the diffusion of dye particles, under an applied potential, is measured and various experimental arrangements to permit this are discussed, the method being based on the Nerst–Einstein diffusion formula. Various types of suitable apparatus are illustrated with reference to their construction. Further, the measurement of the electrical constants of the cell material must be determined and, as only a very small quantity of material is available, difficulties are encountered which are overcome by a method of measurement of the conductivity based upon the value of the decrement for resonant h.f. oscillations and by a method based on the orientation of a platinum ellipsoid between two condenser plates in a homogeneous electric field.
B. J. L.

2024. Mechanism of Action of H.F. Electrical Bistoury. (Study of the Thermic and Mechanical Effects of H.F. Currents upon the Tissues). C. Champy and M. Heitz-Boyer. *Comptes Rendus*, 189. *pp.* 1039–1040, *Dec.* 2, 1929.

The effects of the electrical bistoury are (1) thermic (coagulation), (2) mechanical (disruption) and (3) elongation (late effects upon more distant cells). A suitable section of tissues is determined by the effects of disruption and thermal destruction and the actions at a distance are secondary. The results obtained in practice are dependent on the nature of the h.f. curren tused. With intense, non-continuous quenched currents, coagulation and thermal effects predominate, and this is the reason why the h.f. diathermy bistoury cuts badly and causes great destruction. With continuous waves, coagulation is small and reduced to a thin microscopic layer and, hence, a h.f. non-diathermy bistoury cuts well with a minimum of destruction of tissue. In this case, whilst distant cellular effects are small, but sufficient to prevent secondary hæmorrhage, the more coagulating diathermy bistoury prevents primary hæmorrhage to a larger extent.
B. J. L.

2025. Mechanism of Action of H.F. Electrical Bistoury. (Study of the Mechanical Effects of H.F. Currents and their Hæmostatic Action upon the Blood Vessels) C. Champy and M. Heitz-Boyer. *Comptes Rendus*, 189. *pp.* 1328–1330, *Dec.* 30, 1929.

A continuation of a previous paper [see preceding Abstract] concerning the relative advantages of employing quenched and continuous h.f. currents for electrical cautery. The present paper discusses the effect upon the tissues from the histological aspects and is illustrated by a number of micro-photographs of tissues. It is purely histological, and the authors conclude that use of continuously-maintained h.f. currents is advantageous, since the late effects prevent secondary hæmorrhage.
B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2026. Sorption of Water Vapour by Cellulose and its Derivatives. S. E. Sheppard and P. T. Newsome. *Kodak Research Lab., Comm. No.* 392. *J. Phys. Chem.* 33. *pp.* 1817–1835, *Nov.*, 1929.

The results are given of various series of experiments designed to throw light on relations between the sorption of water vapour and the fine structure (micelle and crystal element), sorption and mechanical structure (porosity), and sorption and chemical constitution (solvatation) of cellulose in various forms. The adsorption and desorption isotherms show that the proportion of water adsorbed at any temperature increases with the vapour pressure to a maximum value at the saturation point. Treatments by which the cellulose is degraded progressively lower the adsorption, which is, however, considerably increased by mercerisation. Celluloses regenerated from cuprammonium solution or from cellulose acetate show sorptions similar to that of the mercerised product. All the cellulosic materials examined exhibit sorption hysteresis, the moisture contents at given vapour pressures being higher on desorption than on adsorption; the hyteresis cycles are repeatable. No complete explanation of this phenomenon is yet available. T. H. P.

2027. Adsorption of Air on Glass as a Function of Temperature. A. S. Adams. *Phys. Rev.* 34. *pp.* 1438–1439, *Dec.* 1, 1929.

With a method previously described [see Abstract 804 (1930)], the adsorption of air on glass is measured as a function of temperature. If the temperature be increased, it is found that the thickness of the adsorbed layer as measured by this method decreases slowly. The rate of this decrease in thickness is not as great as was previously found when the adsorption of air on rock-salt crystal was measured under the same conditions by the same method. It was further found that there was an "ageing" effect of adsorption of air on glass. AUTHOR.

2028. Titanium and Hydrogen. L. Kirschfeld and A. Sieverts. *Zeits. f. phys. Chem.* 145. 3–4. *pp.* 227–240, *Dec.*, 1929.

Titanium 99·4 % pure, prepared by distilling the tetrachloride with sodium amalgam and subsequent purification, began to absorb hydrogen at 375° C.; beyond 400° C. the exothermic process of absorption took place quickly. The highest absorption obtained was represented by the formula Ti_4H_7. The density of a hydride that had absorbed 376 c.c. hydrogen in 1 gm. of titanium was 3·912, the density of the metal itself being 4·523. Similar decreases have been observed with zirconium and thorium. Isobars giving the relation between gm. of Ti and c.c. of hydrogen absorbed under atmospheric pressure were obtained. Between temperatures of 600° and 700° C. the isobars describe a steep gradient with an unsteadiness at about 660° C. Isotherms giving the relation between pressures in mm. Hg. and c.c. of H_2 absorbed by 1 gm. of Ti were also drawn for temperatures of 800°, 640°, 600° and 500° C. The curve for 600° determined by gas emission shows a distinct division into two branches connected by an approximately horizontal portion. Corresponding isobars for the hydrides of titanium, zirconium and thorium show a regular increase of hydrogen absorption from element to element with increasing atomic weight. T. B.

2029. The Gibbs Adsorption Isotherm. Structure of Surface of Ordinary Solutions. J. W. McBain and R. Dubois. *Am. Chem. Soc., J.* 51. *pp.* 3534–3549, *Dec.*, 1929.

The method of McBain and Davies [see Abstract 194 (1928)] has been used to measure the adsorption at the surface of solutions of *iso*-amyl alcohol, acetic, butyric, caproic and nonylic acids, phenol, *p*-toluidine, resorcinol, thymol, camphor and sodium chloride. When a bubble passes through a solution of a simple substance, it carries with it from 2 to 8 times as much of the solute as is predicted by the Gibbs adsorption theorem either in its exact or in its approximate form. The amounts carried are from 2 to 4 times that which can be accommodated in a monomolecular film of closely packed, vertically oriented molecules. These findings fully substantiate those of McBain and Davies and support the views of McBain and of Hardy as to the constitution of surfaces of ordinary solutions.

AUTHORS.

2030. Activation of Metals in High Vacua to any Type of Sorbent, including Inert Gases. Marie A. Schirmann. *Phys. Zeits.* 30. *pp.* 876–879; *Disc.*, 879, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

It is suggested that when a metallic filament is heated in a gas besides the normal adsorption and absorption, a thermal molecular sorption occurs simultaneously owing to the difference between the temperatures of the wire and gas. This thermal molecular sorption is brought about by the transpiration of the gas through the pores of the solid, and its extent is dependent upon the temperature difference between the ends of a pore. If A is the diameter of a pore and λ the mean free path of the gas molecules, then when $A << \lambda$ the equilibrium condition is given (following Knudsen) as $\rho_1/\rho_2 = (T_2/T_1)^{\frac{1}{2}}$. A discussion is entered into of the implications of this type of sorption in determining the optimum conditions for the activation of metals.

F. J. W.

2031. Solutions for Colorimetric Standards. Part II. Relation of Colour to Concentration for Aqueous Solutions of Certain Inorganic Salts. M. G. Mellon. *J. Phys. Chem.* 33. *pp.* 1931–1940, *Dec.*, 1929.

In a previous paper [see Abstract 2164 (1927)] data were given for various solutions in the form of curves representing the percentage transmittancy as a function of the wave-length. The use of such data in specifying colour was discussed, and the transmittancy of a number of inorganic salts and the relationship of colour to their concentrations were calculated for seven solutions. The effects of dilution for red, green and violet on the elementary excitation values and on the dominant wave-length are given.

F. J. B.

2032. Salting-Out Effect with Dichloroethanes and Dichloropropanes. P. Gross. *Zeits. f. phys. Chem.* 6. *Abt. B.* 3. *pp.* 215–220, *Dec.*, 1929.

The solubilities of 1 : 1-dichloroethane, 1 : 2-dichloroethane, 1 : 2 dichloropropane, 1 : 3-dichloropropane and carbon tetrachloride have been measured in water and 0·5 mol. potassium chloride and magnesium-sulphate solutions. A relationship between solubility, salting-out effect and dipole moment of the salted-out substances could not be established.

H. H. Ho.

2033. Sedimentation and Heat of Wetting. B. Illin. *Phys. Zeits.* 30. *pp.* 880–882, *Dec.* 1, 1929. *Paper read before the Deut. Physikertag., Prague, Sept.*, 1929.

This paper contains a study of the inversion of the wetting-thermal effect and the wetting-thermal problem in physico-chemical analysis. Results are given for the inversion by alcohols (ethyl, isopropyl, isobutyl and iso-amyl) in the transition from the hydrophobic carbon powder No. 5*a* to the reverse carbon powder No. 59. The measurement of the heat of wetting is proposed as a new method for the discovery of different compounds in solutions and mixtures. H. H. Ho.

2034. Preparation of Metal Sols in Organic Dispersion Media by Electrical Disintegration. E. Berl, K. Barth and K. Winnacker. *Zeits. f. phys. Chem.* 145. 3–4. *pp.* 298–302, *Dec.*, 1929.

A circuit is described, using a.c. lighting supply at 220 volts and 50 cycles, by which colloidal metal sols in organic media can be obtained without excessive evolution of gas or precipitation of carbon. These sols are stable in oxygen-containing organic liquids (alcohols, aldehydes, etc.), but in " atomising " metals in hydrocarbons an addition of a solution of rubber in hexane is necessary to obtain a stable sol. In the latter cases the maximum concentration of metal in the organic medium is approximately proportional to the amount of rubber stabiliser added, suggesting that the stabilising action of the rubber is due to the formation of addition compounds. The method has been applied to magnesium, zinc, lead, tin, copper, iron and brass. A. J. M.

2035. Solution of Cellulose in Ammoniacal Copper Oxide Solutions. K. Hess and C. Trogus. *Zeits. f. phys. Chem.* 145. *Abt. A.* 6. *pp.* 401–450, *Dec.*, 1929.

It has been shown previously, from the results of polarimetric measurements, that solution of cellulose in ammoniacal copper solution depends on the formation of a complex cellulose-copper compound containing $1Cu : 1C_6H_{10}O_5$. Since the equivalence ratio of the compound in solution is not susceptible of direct confirmation by chemical methods, it appears desirable to study the action of copper on cellulose in the stages of the reaction preceding solution. The results of experiments carried out in conjunction with K. Uhl show that the action of ammoniacal copper-oxide and caustic-alkali solutions on cellulose fibres leads to the formation of characteristic fibre-like compounds of copper-alkali and cellulose, these being of importance in the processes of swelling and solution. T. H. P.

2036. Microscopic Examination of Colloidal Powders in Polarised Light. A. Michel-Levy and H. Muraour. *Comptes Rendus*, 189. *pp.* 1193–1194, *Dec.* 23, 1929.

It has been known for some time, from experiments by Chardonnet, Vignon, Ambronn, and Tissot, that nitrocelluloses of different nitrogen content can be distinguished by their appearance when examined microscopically between crossed nicols, with the help of a quartz wedge. Until recently, however, the method could not be used for the study of colloidal powders containing nitrocellulose. The author has now succeeded in distinguishing various nitrocelluloses colloided with nitroglycerine in solventless, smokeless powders by examining them in thin sections of 2/100 to 3/100 mm. The method is especially useful in distinguishing powders containing nitrocellulose with a nitrogen content of, say, 11·7 %, one of the powders containing a homogeneous nitrocellulose, the other a mixture of 11 and 13 % with an average of 11·7 %. The latter powder has a speed of combustion which may be 15 % greater than that of the homogeneous powder, and is distinguished quite easily by a method similar to that described above for ungelatinised nitrocellulose. T. B.

2037. Colloidal Platinum and its Position in the General Theory of Colloids. S. W. Pennycuick. *Kolloid Zeits.* 49. *pp.* 407–412, *Dec.*, 1929.

Results are given which show that colloidal platinum fits in with Pauli's theory of the structure of colloids. Part of the surface of colloidal platinum consists of a strong platinic acid, probably $H_2Pt(OH)_6$, the hydrogen ion of which is replaceable by the kation of an added salt. The ionisation of the surface acid conditions the stability of the colloid, and forms the source of the negative charge of the colloid particle. The experimental results indicate also that part of the surface contains a feebly acidic oxide, which may be converted by the action of bases into a surface-ionising salt. This reaction forms the basis of the protective action of univalent bases on colloidal platinum, and also explains the peptonisation of the coagulum by such bases. In the preparation by Bredig's method, the presence of oxygen is not necessary for obtaining a stable platinum sol. The extreme conditions at glowing platinum points, together with the electrolysis of the solution, furnish the necessary factors for the formation of stabilising oxidation products. If, however, oxygen is present in excess, the colloidal particles are more stable towards heating, are able to remove a larger amount of base from the solution, and appear to contain a higher proportion of oxides or hydrated oxides. T. H. P.

2038. Synæresis. S. Liepatoff. *Kolloid Zeits.* 49. *pp.* 441–450, *Dec.*, 1929.

The experiments so far made [see Abstract 3182 (1929)] with reversible systems are extended to systems which are irreversible owing to gradual chemical changes, such as solutions of viscose. According to Cross and Bevan, viscose changes in the course of time, because two molecules, each containing one cellulose group, split off SC and SNa to form one xanthogenate molecule containing two cellulose groups by polymerisation. According to Heuser, the original viscose molecule contains four cellulose groups, which are lost by progressive hydrolysis. Together with H. Liepatowa and N. Galperina, the author studies the changes with time in the viscosity and gelatination of viscose sols. They break down by the formation of new, less-hydrated compounds of smaller viscosity. The hydrolysis is accelerated by higher dilution and temperature, and retarded by increased concentrations of the CS_2. The same conditions and presence of neutral electrolytes also favour gelatination, alkalis retard it; after a few days the viscosity rises again. Highly diluted gel may break down in a few hours into a gel consisting essentially of cellulose. Gelatination and synæresis are in general due to a molecular approach of hydrated particles somewhat as in crystallisation, but not to the changes in structure assumed by Kuhn [see Abstract 1696 (1929)]. H. B.

2039. Crystallisation of Gold from the Liquid State. C. O. Bannister. *Inst. of Metals, J.* 42. *pp.* 141–144; *Disc.*, 144–147, 1929.

The solidification of gold beads proceeds from centres with an approximately equal linear velocity in all directions when undercooling, with the consequent "flashing," is prevented. This may be achieved, and radial crystallisation from centres produced, by the addition of traces of platinum metals, by touching the solidifying metal with a gold wire, or by other means. The effects of mutual interference of growth from a number of centres of crystallisation are illustrated by photomicrographs. A. J. M.

2040. Orientation of Single Crystals of Tin. K. Tanaka. *Kyoto Coll. Sci., Mem.* 12. *pp.* 375–379, *Nov.*, 1929. *In English.*

The orientation of many single crystals of tin, formed by recrystallisation in polycrystalline specimens under various conditions, was examined by means of X-rays, to see whether or not it depends upon the previous history of the specimens; and it was found that the dependence of the crystallographic orientation upon the previous treatment was much less than in the case of zinc [see Abstract 39 (1929)]. The favourable crystallographic direction of growth of the tin crystal was also examined, and it was found to be roughly parallel to the basal plane of the tetragonal crystal. AUTHOR.

2041. Space Lattice Distortion and Fibrous Structure in Outer and Inner Zones of Drawn Tungsten Wires. Monocrystalline and Polycrystalline. W. G. Burgers. *Zeits. f. Physik*, 58. 1–2. *pp.* 11–38, 1929.

The difference in space lattice distortion between the various zones of single crystal and polycrystalline tungsten wires, drawn down from 300 μ to 200 μ diameter at different temperatures, are determined by photometric observations on the sharpness of the lines in the X-ray photograph, on progressively reducing the thickness of the wires by etching. In general, the lattice distortion is greater in the outermost zone than in the zone lying immediately below the surface of the wire. In severely cold-drawn wires the distortion increases again towards the centre. If, before etching, the wire is heated to a temperature higher than that at which it was drawn the distortion is reduced. The degree of distortion is closely connected with the changes in the fibre structure over the section of the wire. The differences in distortion between the various zones of the same wire are small compared with the average lattice distortion of the wire as a whole. This is in agreement with the fact that the specific electrical conductivity does not alter appreciably on reducing the diameter of the wire by etching. A. J. M.

2042. X-Ray Studies on the Binary Systems of Iron with Nitrogen, Phosphorous, Arsenic, Antimony and Bismuth. G. Hägg. *Roy. Soc. Sci. Upsala*, 7. 1. *Sec* 4. [95 *pp.*], 1929. *In English.*

Iron-Nitrogen.—Alloys with 0 to 11·23 % by weight N have been examined. The phases identified are: (1) Solid solution in α-iron, limit 0·015 % N at room-temperature. (2) Fe_4N with 5·9 % N, composition very restricted. Lattice: cubic, $a = 3 \cdot 789$ Å., one molecule Fe_4N in the elementary cell; possible structures are discussed. (3) About 8 to 11 % N, possibly based on Fe_3N, with 7·72 % N. The Fe atoms form a hexagonally close-packed lattice, a increasing from 2·695 Å. to 2·77 Å. and c from 4·362 Å. to 4·42 Å. as the N content increases; the position of the N atoms is uncertain. (4) Fe_2N with 11·2 % N, the iron atoms forming an orthorhombic lattice, in which $a = 2 \cdot 758$ Å., $b = 4 \cdot 819$ Å., $c = 4 \cdot 419$ Å., the elementary cell containing 4 iron atoms. The position of the N atoms is uncertain. *Iron-Phosphorus.*—Alloys with 0 to 28·8 % have been ex-

amined. The phases identified are: (1) solid solution in α-iron. (2) Fe_3P; lattice: body-centred tetragonal, with $a = 9 \cdot 090$ Å., $c = 4 \cdot 446$ Å., the elementary cell containing 8 molecules Fe_3P; space group probably S_4^2. (3) Fe_2P; lattice:hexagonal, with $a = 5 \cdot 852$ Å., $c = 3 \cdot 453$ Å., the elementary cell containing 3 molecules Fe_2P. A structure in D_{3h}^3 with non-equivalent iron atoms is probable. (4) FeP; single crystals have not been obtained and powder photographs are too complicated for reliable analysis. *Iron-Arsenic.*—Alloys with 0 to 56·9 % As have been examined. The phases are: (1) solid solution in α-iron extending to 5 % As at room-temperature, (2) Fe_2As; simple tetragonal lattice with $a = 3 \cdot 627$ Å., $c = 5 \cdot 973$ Å., elementary cell containing 2 molecules Fe_2As. Possible space groups are discussed. (3) 40 to 50 % As: this phase is only stable above 795° C., and cannot be retained at room-temperature by quenching. (4) FeAs.; orthorhombic lattice with $a = 3 \cdot 366$ Å., $b = 6 \cdot 016$ Å., $c = 5 \cdot 428$ Å., 4 molecules in the unit cell. The structure is probably of a deformed nickel arsenide type belonging to space-group V_h^{16}. *Iron-Antimony.*—(1) Solid solution Sb in α-iron up to 6–7 % Sb at room-temperature, (2) 63·5 to 65·5 % Sb; hexagonal lattice, a decreasing from 4·106 Å. to 4·066 Å., and c from 5·145 Å. to 5·127 Å., as the Sb-content increases. In the unit cell 2 Fe and 2 Sb atoms form a lattice of the nickel arsenide type, the excess Fe atoms being located in the interstices of this lattice. This phase is to be considered as a solid solution of Fe in a compound, FeSb (68·6 % Sb), which does not exist under ordinary conditions, but is stabilised by the dissolved Fe atoms. (3) $FeSb_2$; orthorhombic lattice, with $a = 3 \cdot 189$ Å., $b = 5 \cdot 819$ Å., $c = 6 \cdot 520$ Å., the elementary cell containing 2 molecules $FeSb_2$. The space group is V_h^{12}. *Iron-Bismuth.*—The metals are immiscible and form no compounds.
A. J. M.

2043. Corrosion of Cemented and Nitrated Steel. L. Guillet and M. Ballay. *Comptes Rendus*, 189. *pp.* 961–963, *Dec.* 2, 1929.

Specimens of a series of alloy steels were cemented and nitrated (heated in a stream of ammonia) and subsequently subjected to corrosion tests (dilute H_2SO_4, $CuSO_4$, NaOH, sea-water, etc.). The original paper, which is itself a summary, should be consulted for details of the results.
A. A. D.

2044. Explosion of Hydrogen-Air Mixtures in a Closed Vessel. Parts I and II. B. H. Thorp. *Phil. Mag.* 8. *pp.* 813–833, *Dec.*, 1929. *Supplement.*

A survey is made of the results obtained during the last 20 years of the maximum pressures developed in the explosion of mixtures of hydrogen, oxygen and nitrogen in closed vessels. The wide variation in these results is attributed mainly to the differences in size and shape of the explosion vessel, large spheres with central ignition giving the highest pressures. It is suggested that combustion lags behind inflammation, and that in the large spheres combustion has, on an average through the vessel, reached a more advanced stage at the moment of maximum pressure. A new diaphragm indicator is also described which is designed to overcome the defects found to exist for rapid explosions in the Hopkinson indicator. The maximum pressures recorded by this new indicator in a sphere 45·4 cm. diameter are amongst the highest found by any workers. Six series of explosions in this vessel are described; in each series the ratio of nitrogen to oxygen is kept constant, and the resulting " air " mixed with various proportions of hydrogen. The results are given in tables and curves in the forms: (1) ratio of maximum to initial pressure; (2) " apparent mean specific heat of steam " between the initial and maximum temperatures for each explosion. T. B.

2045. Heats of Dissociation and Absorption Spectra of some Complex Molecules. T. Iredale and W. N. W. Wallace. *Phil. Mag.* 8. *pp.* 1093–1099, *Dec.*, 1929.

The authors discuss the relationship between the thermal energy required to decompose a substance and the minimum of light energy required to bring about the same transformation. Using a Hilger quartz spectrograph they have carried out experiments on the absorption limits of certain organic iodine compounds in the liquid form, including methyl iodide and ethyl iodide. From these measurements they have calculated the heat of dissociation from the absorption limit and have compared these results with the heat of binding of the carbon and iodine as calculated from thermochemical data. W. C. S. P.

2046. Thermochemistry of Chlorine and Hypochlorous Acid. W. A. Roth. *Zeits. f. phys. Chem.* 145. *Abt. A.* 3–4. *pp.* 289–297, *Dec.*, 1929.

Cryoscopic determinations yield reliable values for the hydrolysis constant of chlorine dissolved in water ($K = 1\cdot5 . 10^{-4}$ to $1\cdot6 . 10^{-4}$ for 0° C.), which are in good agreement with earlier values obtained by other methods, but with bromine only the order of magnitude (10^{-9}) is obtained for the constant, on account of interfering side-reactions. A tentative value of about 6·9 k.cal. at 18° C. is calculated for the heat of solution of gaseous chlorine in water in the absence of hydrolysis. Consideration of previous results on the heat of dilution of HOCl and the distribution coefficient between water and carbon tetrachloride leads to values for the hydration constant $[HOCl]^2/[Cl_2O]$ of 282 at 0° C. and 115 at 19° C. The heat of hydration (about + 8 k.cal.) for the reaction Cl_2O, aq. + $H_2O = 2\ HOCl$, aq., derived from the heat of dilution, gives satisfactory results for the variation of the hydrolysis constant with temperature. The distribution coefficient of Cl_2O between carbon tetrachloride and water at 0° C. is 2·22. A. J. M.

2047. Thermochemical Revisions. Part II. W. A. Roth and G. Becker. *Zeits. f. phys. Chem.* 145. *Abt. A.* 6. *pp.* 461–469, *Dec.*, 1929.

This paper continues the work of thermochemical revisions [see Abstract 1239 (1930)] in inorganic chemistry, wherein the calorimetric bomb is employed for the study of the oxidation of zirconium and chromium, and for the reduction of chromium trioxide (Cr_2O_3) to chromium sesquioxide (Cr_2O_3). The results found, as in previous revisions (*loc. cit.*), are higher than the hitherto accepted values, and in the case of zirconium oxide (ZrO_2) are of the order of 50 % higher. The new value is in close agreement with that obtained from the heat of formation—atomic number curve, and the materials employed are stated to be purer than those used previously, with the additional advantage of a direct method. H. H. Ho.

2048. Temperature Measurements at Active Electrodes. Parts I and II. B. Bružs. *Zeits. f. phys. Chem.* 145. *Abt. A.* 3–4. *pp.* 283–288, *Dec., and* 145. *Abt. A.* 6. *pp.* 470–476, *Dec.*, 1929.

In Part I, a calorimetric method is proposed for measuring the entropy changes of separate electrode processes analogous to changes of free energy. In the case of nickel electrodes it is shown that very characteristic temperature effects arise. Chemically induced currents are found which are explained by lattice changes that produce increased activity towards oxygen. Part II contains measurements of the temperature effects due to the separation of oxygen, hydrogen and silver at bright platinum electrodes, when only in the case of hydrogen did the effects vary with time. A quantitative comparison of the effects gave $O_2 : H_2 : Ag = 7 \cdot 3 : 4 \cdot 9 : 0 \cdot 6$. H. H. Ho.

2049. Volta Effect. Influence of Oxidation of Electrodes. E. Dubois. *Comptes Rendus*, 189. *p*. 1260, *Dec*. 30, 1929.

Eight different metals were exposed in turn to pure oxygen: (1) when cold and under a pressure of a few cm. of mercury for several minutes, and (2) when heated for a few seconds. In each case the metal becomes electronegative, in the case of Pd rising to > 0·8 volt. It is considered that the gas is absorbed or even combined with the metal when producing this change. If the metal is heated *in vacuo* the oxygen disappears and the metal becomes electropositive. R. S. R.

2050. Theory of the Valve Electrode. Anodic Behaviour of Aluminium. W. J. Müller and K. Konopicky. *Zeits. f. phys. Chem.* 145. 3–4. *pp*. 241–256, *Dec*., 1929.

Güntherschulze's objections [see Abstract 1260 (1930)] to the authors' experiments [see Abstract 3441 (1929)] are shown to be unfounded. By means of Güntherschulze's own results it is proved that the cataphoretic theory of the valve electrode is capable of interpreting qualitatively and, in many cases, quantitatively the observed facts. T. H. P.

2051. Dissociation of Acids in Methyl and in Ethyl Alcohol. D. M. Murray-Rust and H. Hartley. *Roy. Soc., Proc*. 126. *pp*. 84–106, *Dec*. 2, 1929.

The electrical conductivity at 25° C. of the solutions of the following acids in methyl and ethyl alcohol has been measured over the range $0 \cdot 0001\,N$ to $0 \cdot 002\,N$:—HCl, $HClO_3$, $HClO_4$, $HEtSO_4$, $HSO_3C_6H_5$, HNO_3, HIO_3, HCNS. The first five of these acids are strong electrolytes in alcoholic solution. Comparison with the theory of Onsager shows that there is probably more association in ethyl alcohol than in methyl alcohol. The hydrion has a mobility of 142·0 in methyl alcohol and 59·5 in ethyl alcohol. Nitric, thiocyanic and iodic acids are weak electrolytes in alcoholic solutions and dissociation constants have been calculated for them. Strong and weak acids in alcoholic solution can be distinguished by the addition of small quantities of water, which causes a large decrease of conductivity in the case of strong acids and a corresponding increase with weak acids. AUTHORS.

2052. Kinetics of the Electrodeposition of Hydrogen and Oxygen. F. P. Bowden. *Roy. Soc., Proc*. 126. *pp*. 107–125, *Dec*. 2, 1929.

The kinetics of the electrodeposition of H and O on metallic electrodes was studied. Previous work had indicated that at the H or O potential the electrode surface was covered with a single layer of gas adsorbed on the metal atoms. It is suggested that in the forces acting at the metal surface this adsorbed gas is distorted forming dipoles orientated on the surface; the potential across the interface V being controlled by the number and electric moment of these gas dipoles. The evolution of H and O is then treated as an ordinary surface reaction in which only those dipoles possessing a certain energy of activation can leave the surface to form molecular gas. Then the number N capable of leaving the surface is given by $N = N_0 e^{-(\omega - \alpha V)/RT}$, where $\omega - \alpha V$ is a measure of the necessary energy of activation, α being a measure of the proportionality of the energy of activation to V and ω the necessary energy when $V = 0$. It was found experimentally that α is a constant, the same for both H and O, and on pure metals nearly 0·5. An expression is found for the dependence of the reaction velocity and the electrode potential on temperature. From the temperature coefficient of the reaction velocity or of the potential the energy of activation is calculated. For H on a mercury kathode and O on bright platinum it is 15,000 and 22,000 cal. respectively. For H on bright platinum it varies from 7000 to 9000 cal., depending upon the state of activity of the surface. "Transfer resistance" is considered to be a secondary effect occurring only at high current densities. [See also Abstract 1659 (1930).] J. J. S.

2053. Electrophoresis of Protein Sols in the Presence of Gold Sols. E. B. R. Prideaux and F. O. Howitt. *Roy. Soc., Proc.* 126. *pp.* 126–137, *Dec.* 2, 1929.

An account is given of investigations of the electrophoretic velocities of proteins in the case of solutions containing both proteins and gold sols. The macro-method was employed, and tables are given of the electrophoretic velocities of albumen, gelatin and casein. J. J. S.

2054. Thermodynamic Analysis of Osmotic Pressures of Protein Salts in Solutions of Finite Concentration. G. S. Adair. *Roy. Soc., Proc.* 126. *pp.* 16–24, *Dec.* 2, 1929.

The observed osmotic pressure (p) of a solution of a protein salt has been analysed in terms of the partial osmotic pressure of the protein ions themselves (p_p) and the "ion pressure difference" (p_i), due to the unequal distribution of diffusible ions across a membrane which is permeable by all crystalloids, but impermeable by the protein, under conditions where the concentrations of the ions are too great for the application of the formulæ for the osmotic pressures of infinitely dilute solutions of colloidal electrolytes due to Donnan. p_i is found to be $= RT\int_0^u m_p n_p du$, where m_p = gramme-mols. of protein per litre of solvent, n_p is the mean value of the electric charge or valence of the protein ions, in the assemblage of protein ions of different valences; $u = E \times F/RT$, where E is the membrane potential of the protein salt [see Abstract 2330 (1929)]. Assuming $p = p_p + p_i$, in a series of experiments on hæmoglobin in equilibrium with phosphate buffers the values of p_p determined by this and a previous method [see Abstract 625 (1929)] agree within 1–6 %. This agreement of the determination of the partial pressures of hæmoglobin is important in view of the doubts as to the possibility of making even approximate allowances for the effects of the unequal distribution of diffusible ions expressed by Svedberg, Patrick, and others. H. H. Ho.